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NEW SPECIES OF SCHOENUS (CYPERACEAE) AND TRITHURIA (HYDATELLACEAE)

by

D. A. Cooke*

SUMMARY

Two new species, *Schoenus capillifolius* from Western Australia and *Trithuria lanterna* from the Northern Territory, are described. The significance of the basicarpic habit of the former is discussed.

DESCRIPTIONS

Schoenus capillifolius D. A. Cooke sp. nov.

Herba glabra annua subaquatica. *Caulis* brevissimus, suberectus in strato superiore substrati repetite ramificans caespes foliorum densi formans. *Folia* basales, vaginis apertis angustis scariosis sub-atropurpureis usque ad 3mm longis in laminis laxis filiformibus usque ad 10 cm longis 0.2 mm latis abrupte transientibus. *Culmi* nulli; spiculae sessiles in caespitibus foliorum ramos ultimos caulis terminans, solitariae uniflorae. *Glumae* 2 oppositae lineares subscariosae, tubum circum flosculum formandum arcte vaginantes; externa 7-10 mm longa, interna vix brevior. *Rhachilla* nulla. *Setae hypogynae* 6 plumosae albae sericeae c. 3mm longae, in situ saepe compactae intertextae circum ovarium tubi fundum basi complentes. *Stamen* 1 anticum, filamento capillario 7-12 mm longo; anthera pallida linearia c. 2 mm longa. *Stylus* tenuis c. 8 mm longus, glaber, cum ovario inarticulatus, stigmatis 3 brunneis filiformibus. *Nux* 1-1.3 mm longa, ovoidea turgida vix trigona, alba translucida fragilis, superficies ordinatione cellulosis hexagonis. *Semen* ovoideum 0.8 mm longum, testis laevi brunneis, endospermio albo farinaceo.

Glabrous subaquatic annual herb. *Stem* very short, semi-erect within the upper substrate, repeatedly branching to form dense leaf tufts at surface level. *Leaves* basal, with narrow scarious somewhat atropurpureous open sheaths up to 3 mm long passing abruptly into lax filiform laminae up to 10 cm long by 0.2 mm wide. *Culms* absent, the spikelets sessile in the leaf tufts, solitary, 1-flowered, terminating the ultimate branches of the stem. *Glumes* 2, opposite, linear, almost scarious, closely sheathing to form a tube around the floret; outer glume 7-10 mm long, the inner slightly shorter. *Rhachilla* absent. *Hypogynous bristles* 6, white silky plumose, c. 3 mm long, often packed and interwoven around the ovary to fill the expanded base of the tube. *Stamen* 1, anterior, with a capillary filament 7-12 mm long; anther pallid, linear, c. 2 mm long. *Style* slender, c. 8 mm long, glabrous, not articulate with the ovary, with 3 filiform stigmas. *Nut* 1-1.3 mm long, ovoid, turgid, scarcely trigonous, white-translucent, fragile, the faces with a hexagonal cell pattern. *Seed* ovoid, 0.8 mm long, with smooth brown testa and white farinaceous endosperm.

Type Collection:

Western Australia—Upper Swan, 11.xi.1959, *R. D. Royce 6148* (Holo: PERTH!)

Also examined:

Western Australia—Ellen Brook Tortoise Reserve (J. B. Martyn), 30 km north of Midland, 10.xi.1978, *G. J. Keighery 2456* (MEL 5703851!, PERTH).

Distribution:

Known only from seasonally flooded claypans along Ellen Brook north of Midland Junction, Darling District, Western Australia.

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Muelleria 4(4):299-303 (1981).

Fig. 1. Fruit of *Schoenus capillifolius* (Holotype), showing one of the six hypogynous bristles fully extended.

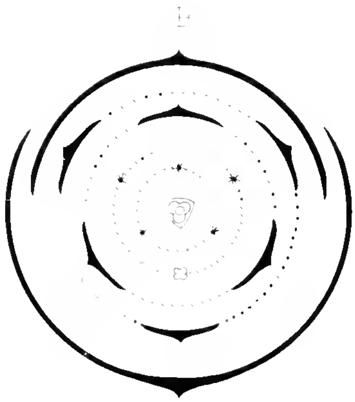

Fig. 2. Floral diagram of the spikelet of *Schoenus capillifolius*, showing outer and inner glumes, six hypogynous bristles, the single stamen with five "lost" stamens indicated by asterisks, and the tricarpellate ovary in the centre.

ECOLOGY:

The filiform leaves are associated with the semi-aquatic habitat, being supported by the water. Flowering occurs in the spring, when the water level has fallen to about 10 mm above the mud in which the plant is rooted (Keighery, pers. comm.). The function of the tube formed by the glumes is to hold the stigmas and stamen above water level; it is suggested that the function of the dense wadding formed around the ovary by the setae is to exclude water from the spikelet.

DISCUSSION:

BASICARPY: In addition to the complex terminal inflorescence typical of the family, several members of the Cyperaceae produce solitary florets at soil level. A group of amphicarpic *Scirpus* species produce glumeless florets, usually female, within the leaf sheaths at the base of the inflorescence; there is a trend towards basicarpy within this group by the development of these basal florets and reduction of the distal part of the inflorescence (Raynal, 1976). Basal spikelets, usually containing bisexual florets but distinct from the aerial inflorescence on the same plant, are known in *Bulbostylis* (Haines, 1971) and in at least one *Eleocharis* species (Raynal, l.c.). The development of basal spikelets may provide an additional or alternative reproductive strategy to the production of seed in aerial spikelets for dispersal away from the parent plant. Basicarpy can be a means to atelechory, defined by van der Pijl (1972) as the limitation of dispersal to the already occupied, obviously suitable spot. This represents an economy in seed production for species in a restricted habitat surrounded by unfavourable areas, and effectively replaces perennating organs in an annual.

The South African genus *Trianoptiles*, which, like *Schoenus*, is placed in the tribe Rhynchosporeae, produces tubular basal spikelets each containing a female floret and morphologically distinct bisexual florets in a scapose inflorescence. The habitats of the three species are swamps in Cape Province (Adamson & Salter,

1950). *Schoenus capillifolius*, also native to a swamp habitat, has developed superficially similar basal spikelets with bisexual florets while scape development has been suppressed. In line with the strategy of atelechory the nut is not adapted as a resistant diaspore with a hard pericarp since it is retained where it is produced; the pericarp is rather fragile, liberating the seed when the whole spikelet breaks up. Two other *Schoenus* species from the Western Australian sand heaths which have solitary spikelets terminating reduced scapes (Blake, 1949) have developed basicarpy independently.

AFFINITIES: *S. capillifolius* may be placed in the section *Helothrix* Kükenthal (1938), and is related to the aquatic *S. natans* (F. Muell.) Benth. and *S. tenellus* Benth. It resembles both species in its almost capillary foliage, reduced inflorescences, and herbaceous glumes, but differs in the greatly abbreviated stems and the one-flowered tubular spikelet. *S. capillifolius* is further distinguished from *S. natans* by the solitary stamen and glabrous, obscurely angled nut, and from *S. tenellus* by the presence of hypogynous setae.

Trithuria lanterna D. A. Cooke sp. nov.

Herba glabra annua rubescens caule brevissimo radicibus fibrosis. *Folia* basalia linearia 6-17 mm longa usque ad 0.8 mm lata, apicibus acutis. *Scapi* absentes. *Capitula* sessilia, pluria, unumquidque flosculis masculis 1-2, flosculis foeminis 6-18, bracteis c. 4 herbaceis erectis angusto-lanceolatis 2-3 mm longis involucratum. *Stamen* anthero linear-elliptico purpurascente c. 0.7 mm longo, filamento c. 1 mm longo. *Ovarium* flosculi non vidi. *Fructus* indehiscens, usque ad 0.4 mm longus 0.2 mm latus, ovoid-trigonus superficiebus 3 delicatis hyalinis inter costas 3 prominentes; in pedicello fragili usque ad 0.4 mm longo; pilibus stigmaticis 2-3 persistentibus, fructi maturi pilibus implexis coherentes. *Semen* unicum, ovoideum c. 0.3 mm longum, pallidum translucens praeter apicem fuscum opacum; testa mellea laevis nitens. (Descriptio typi.)

Glabrous annual herb, often becoming red-tinted, with a very short stem and fibrous roots. *Leaves* basal, linear, 5-18 mm long and up to 0.8 mm wide, tapering to acute apices, with anomocytic stomata on both surfaces. *Scapes* absent. *Heads* several, sessile, each with an involucre of about 4 erect narrow-lanceolate herbaceous bracts 2-3 mm long containing 6-20 female florets loosely grouped into 3-6 bundles and 1-2 male florets. *Stamen* with a ± purple, linear-elliptic anther c. 0.7 mm long on a filament up to 1.5 mm long. *Ovary* ovoid, c. 0.2 mm long, shortly pedicellate, with about 3 terminal stigmatic hairs 1.5-2 mm long, each consisting of a single row of cylindrical cells. *Fruit* indehiscent, up to 0.4 mm long and 0.2 mm wide, ovoid-trigonous with 3 delicate hyaline panels between 3 prominent ribs containing vascular bundles. Fruiting pedicel up to 0.5 mm long, fragile, the mature fruits cohering by the tangled persistent stigmatic hairs. *Seed* 1, ovoid, c. 0.3 mm long, pallid and translucent except for a dark apex; testa honey-coloured, smooth, shining. (English description based on all material examined.)

The epithet *lanterna* is derived from the Latin noun *lanterna*, a lantern, and refers to the pericarp with three transparent panels and a framework of three opaque bars.

TYPE COLLECTION:

Northern Territory—South Bay, Bickerton Island, 14 June 1948, *R. L. Specht 566* (Holo: MEL 1517931!; Iso: BRI 256564!)

ALSO EXAMINED:

Northern Territory—Little Lagoon, Groote Eylandt, 27 May 1948, *R. L. Specht 413* (MEL 1517930!; BRI 256563!).

DISTRIBUTION:

Known only from Bickerton Island and Groote Eylandt, Arnhem Land, Northern Territory, but apparently overlooked due to its small size. It may be ex-

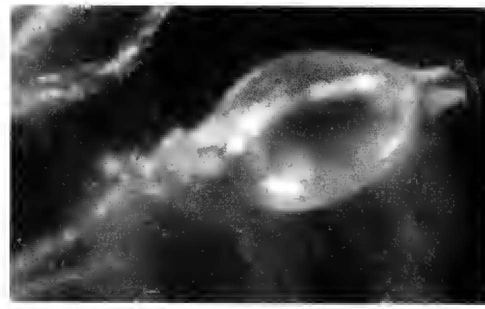

Fig. 3. Fruit of *Trithuria lanterna* (Holotype). Pedicel at right; persistent tangled stigmas at left.

pected to occur elsewhere along the north coast of Australia. *T.lanterna* is the only species of *Trithuria* Hook. f. recorded for tropical parts of the continent.

ECOLOGY:

Annual, growing during the wet season and flowering at the beginning of the dry season in May. Both collections cited here are from seasonal swamps dominated by *Melaleuca leucadendron* (Specht, 1958).

DISCUSSION:

The collections upon which this species is based have been referred previously (Specht, 1958) to *Centrolepis pusilla* (R. Br.) Roem. & Schult.

The family Hydatellaceae (Hamann, 1976) contains two genera, *Hydatella* and *Trithuria*. The species here described is placed in the latter genus on the basis of its bisexual inflorescences and 3-ribbed fruits.

In *Trithuria submersa* Hook. f. the fruit dehisces by 3 caducous panels, leaving a framework formed by the 3 vascular ribs (Hooker, 1858). The released seed is the disseminule and has a thick, sculptured testa which may be an adaptation to hydrochory, rendering the seed unwettable and thus able to float on the surface film.

Fig. 4. Plant of *Trithuria lanterna* (several leaves and bracts removed), showing flowering heads, x18 (BRI 256563).

In *Hydatella*, the fruit is shed entire; there are about 3 main vascular bundles in the pericarp, but these are rather irregularly arranged and do not form definite ribs. The whole fruit is the disseminule and the testa, which is not exposed to the environment, is smooth and thin (Hamann et al., 1979). *T. lanterna* provides a morphological link between the two fruit/seed types. It has the prominently 3-ribbed fruits of *T. submersa* but these are indehiscent and contain seeds with smooth and thin testas as in *Hydatella*.

The leaves and bracts of *T. lanterna* lack the distinct midvein which is visible in material of *T. submersa*. The leaves grade into the involucral bracts rather indistinctly, as there is no scape; in *T. submersa* the scape is developed after anthesis or suppressed but the head is always defined by the short acuminate bracts.

The stomata of *T. lanterna* are similar to those of the subaquatic *T. submersa*, whereas two fully aquatic *Hydatella* species examined by Cutler (1969) lack stomata.

ACKNOWLEDGEMENTS

The author wishes to thank the Directors of the PERTH and BRI herbaria for the loan of collections, and the officers of CANB, DNA and NT for searching their collections for material relevant to the *Trithuria* study. I also thank Greg Keighery of Kings Park, Perth, for field data and material, and Karen Wilson of the National Herbarium of New South Wales for advice. Grateful thanks are also due to the staff of the National Herbarium of Victoria, Melbourne, where this paper was prepared, and especially to the Director, Dr D. M. Churchill, for preparing the photographs, and to Miss Anita Podwyszynski for the drawing of *Trithuria*.

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Manuscript received 15 August 1980.

STUDIES ON MACQUARIE ISLAND LICHENS 1: GENERAL

by

REX B. FILSON*

INTRODUCTION

This article serves as an introduction to a series of papers on the taxonomy and distribution of Macquarie island lichens, and includes a key to all lichen genera recorded from this Island. Future papers will present the results of the author's revisions.

GEOGRAPHY

Macquarie Island is situated in the Southern Ocean on longitude 158° 52′ E and between latitudes 54° 29′ S and 54° 47′ S. It is the southern-most island in the chain comprising Bluff, Stewart, Snares, Auckland and Campbell Islands which stretch south from New Zealand along the New Zealand Plateau—Macquarie—Balleny Ridge. It lies approximately 1530 kilometres south-south-east of Tasmania, Australia, and about 1370 kilometres north of the Antarctic Continent (Fig. 1).

The island, a dependency of Tasmania, is 34 kilometres long and 7 kilometres wide at its widest point (Fig. 2). The main body of the island consists of a large central plateau, about 250 metres above sea level, which is undulate on the top and divided into two halves by a low col. The southern half is the highest, rising to a maximum 433 metres at Mount Hamilton. The plateau area is covered with grass and herbs and is studded with lakes and tarns. The edge of the plateau drops abruptly into the sea on the western side, separated from it by tumbled rocks or in places a narrow shingle beach. By comparison the eastern escarpment drops steeply down onto a wide raised beach terrace.

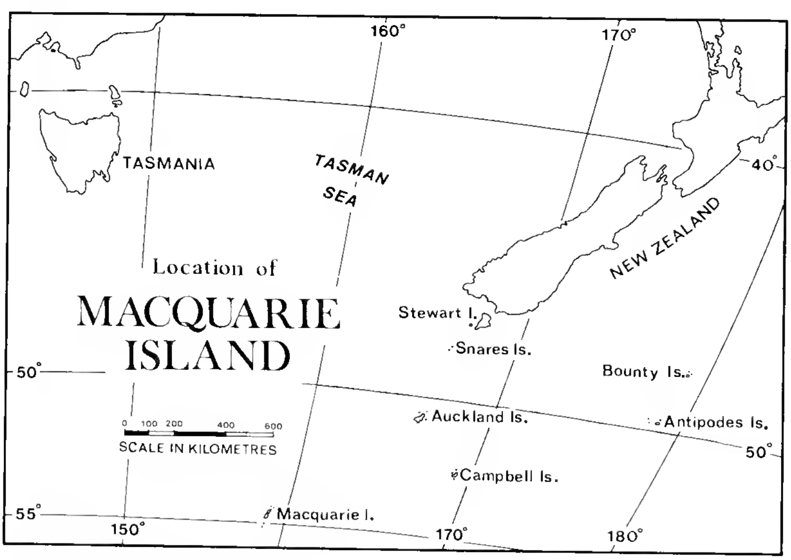

Fig. 1. Location of Macquarie Island.

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This subantarctic island lies north of the Antarctic Convergence, and is subject to persistent wind and cloud cover. There is little bright sunshine and it is mostly wet and cold. Rain, drizzle, snow and hail are frequent. The annual precipitation is 1020 mm. Temperatures fluctuate from near 0°C to about 15°C and the daily range is rarely more than 3.5°C.

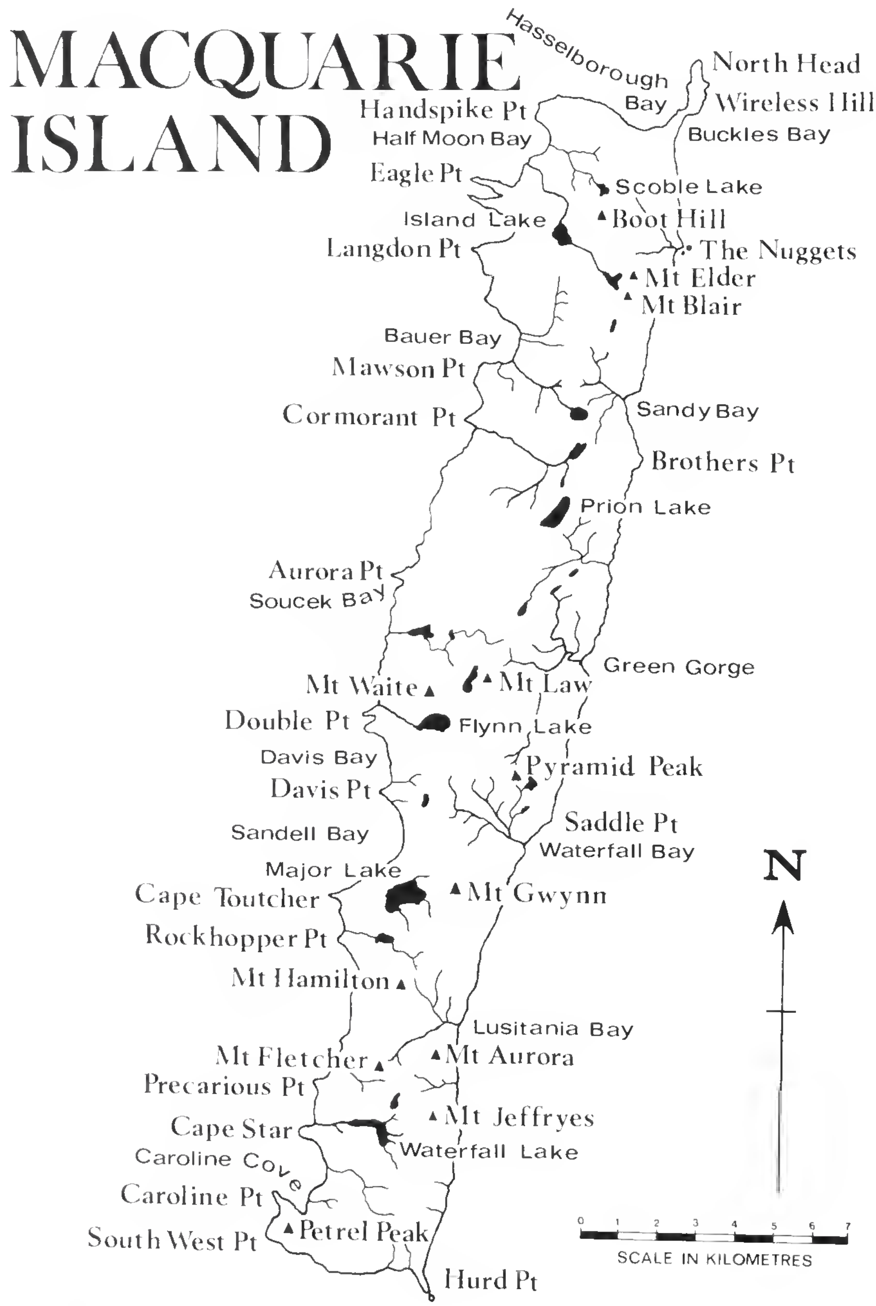

Fig. 2. Macquarie Island.

HISTORY

On 11 July 1810 Macquarie Island was sighted for the first time from the deck of the brig *Perseverance* under the command of Captain Fredrick Hasselburgh (Law & Burstall, 1956: 1). The *Perseverance* was en-route from Sydney to Campbell Island with provisions and stores for the sealers working on that island.

Hasselburgh named this new island after Lachlan Macquarie, then Governor of the Colony of New South Wales. He landed a party of eight men with provisions and salt; this gang was the first of many to engage in the steady slaughter of the fur seals which inhabited the island. Exploitation of the fur seals continued for the next ten years, by which time they were nearly exterminated.

It was at this time that the Australian sealing companies turned their attention to the sea elephants, killing them for their oil. By 1834 when the elephant seal was no longer present in workable numbers, the sealing ventures on the island had almost ceased (Cumpston 1968: 70-72).

On 10 January 1840, the United States Exploring Expedition of 1838-1842 under the command of Lieutenant Charles Wilkes arrived at the island. He found the place ". . . dreary and inhospitable.".

The next fifty years saw very little activity in the seal-oil industry on Macquarie Island. The *Jessie Niccol* owned by Cormack, Elder and Company, under the directorship of William Elder, a New Zealand chemist, visited the island several times for oil. Joseph Hatch, also a New Zealander, reopened the industry in 1873 taking over the operations of the Elder Company. The production of seal oil and penguin oil continued under his direction until 1919. The licence to kill seals and penguins on the island was cancelled on 2 February 1920 (Cumpston 1968: 316).

Captain R. F. Scott, en-route to the Antarctic Continent in the *Discovery*, paid a short visit to the island on 22 November 1901 and the British Antarctic Expedition 1907-1909, led by Sir E. H. Shackleton, landed at Lusitania Bay. Both of these visits were very brief.

On 11 December 1911, the Australasian Antarctic Expedition (A.A.E.), under the leadership of Sir Douglas Mawson set up a scientific base on the isthmus at the foot of Wireless Hill and members of this expedition spent two years on the island.

The British, Australian and New Zealand Antarctic Research Expedition (B.A.N.Z.A.R.E.) 1929-1931, also led by Sir Douglas Mawson, landed in Buckles Bay on 2 December 1930 for a short stay.

Macquarie Island was declared a Sanctuary for animals and birds on 17 May 1933 upon the recommendation of the Animals and Birds Protection Board of Tasmania. It was not revisited until 7 March 1948 when H.M.A.S. *Labuan* arrived with the first Australian National Antarctic Research Expedition (A.N.A.R.E.). This expedition established a station, at the site of the previous A.A.E. base, which has been continuously occupied since its formation.

HISTORY OF LICHENOLOGICAL INVESTIGATIONS

Macquarie Island has been visited by a number of scientific expeditions in the course of its short history. Few of the early expeditions contributed greatly to the knowledge of the lichen flora. The first known collection of Macquarie Island plants was forwarded to Sir W. J. Hooker at Kew in about 1830, by the Superintendent of the Sydney Botanic Gardens (Cheesman 1919: 10). The eight species mentioned in this publication are only of vascular plants.

Dr. **J. H. Scott** of Otago University, New Zealand, made a brief visit in 1880 for the special purpose of investigating the flora and fauna, and to him is credited the first observations of the lichens of this island (Scott, 1882):

> "*Azorella selago* grows on the hillsides forming globular masses often 4 feet across. These are green on the surface where the living part of the plant lies as a crust to the great mass of debris which forms the interior. This is the decaying remains of former years growth . . . The whole makes a solid mass on which

one can stand . . . The young shoots are closely packed together and made so uniform a surface that lichens and other small plants are sometimes found growing on it."

The following is the list of lichens included in his report:

Stereocaulon ramulosum; *Sphaerophoron coralloides* (?); *Cladonia cariosa*; *Cladonia pyxidata*; *Parmelia parietina*; *Lecanora parella*; *Lecidea coarctata*.

In 1894, **A. Hamilton**, then Registrar of the Otago University, visited Macquarie Island, but unfortunately a portion of his collections had to remain on the island for some months after his return. When the remainder of his collection eventually arrived in New Zealand . . .

"The mosses and lichens collected were so injured by the wet, and by the delay of some months which occurred before they were brought up from the island, that I fear it will probably be impossible to give a list of any value." (Hamilton 1895: 569).

The Australasian Antarctic Expedition 1911-1914, established a base on Macquarie Island and the expedition's biologist **H. Hamilton** (son of the former Hamilton) made a collection of lichens. Five fragmentary specimens were sent to Dr. C. W. Dodge at the Missouri Botanical Garden, U.S.A. who published his determinations in the BANZARE Reports (Dodge, 1948):

Pseudocyphellaria glabra (Hook.f. & Tayl.) Dodge; *Stereocaulon corticulatum* Nyl.; *Stereocaulon* sp. [later *S. macquariensis* Dodge (Dodge, 1968)]; *Parmelia sublugubris* Dodge; *Cladia aggregata* (Sw.) Nyl.

The remainder of the collection was erroneously forwarded to the British Museum and was unfortunately destroyed by bomb blast during the blitz of London (Dodge, 1948: 5, 13 footnote).

The British, Australian and New Zealand Antarctic Expedition of 1929-1931 collected almost 100 samples, which were sent to Dodge in Missouri. In the BANZARE Reports he described ten species as new (Dodge, 1948); these are marked with an asterisk in the following list of species:

**Buellia mawsoni* Dodge; *Cladia aggregata* (Sw.) Nyl.; **Cladonia mawsoni* Dodge; *Cladonia sarmentosa* (Tayl.) Dodge; *Cladonia subdigitata* Nyl. var. *subalbinea* Dodge; *Coccocarpia kerguelensis* Dodge; *Coenogonium subtorulosum* Müll. Arg.; **Gasparrinia macquariensis* Dodge; **Lecania johnstoni* Dodge; *Mastodea* sp. [later *M. macquariensis* Dodge (Dodge 1970)]; *Menegazzia circumsorediata* Santesson; **Microthelia macquariensis* Dodge; *Mykoblastus campbellianus* (Nyl.) Zahlbr.; *Pannaria* sp.; *Parmelia sublugubris* Dodge; *Parmelia tenuirima* Hook.f. & Tayl.; *Peltigera* sp; *Pertusaria tyloplaca* Nyl.; *Pseudocyphellaria glabra* (Hook.f. & Tayl.) Dodge; *Psoroma versicolor* Müll. Arg.; *Pyrenodesmia inclinans* (Stirt.) Dodge; *Pyrenodesmia subpyracea* (Nyl.) Dodge; **Ramalina banzarensis* Dodge; *Ramalina inflata* Hook.f. & Tayl.; *Rinodina peloleuca* Nyl.; *Rinodina subbadioatra* (Knight) Dodge; **Siphulastrum cladinoides* Dodge; **Siphulastrum usneoides* Dodge; *Stereocaulon corticatulum* Nyl.; *Stereocaulon leptaleum* Nyl.; **Stereocaulon pulvinare* Dodge; *Stereocaulon submollescens* Nyl.; *Thelidea* sp.; *Usnea arida* Mot. var. *muscicola* Dodge; *Usnea contexta* Mot.; *Usnea torulosa* (Müll. Arg.) Zahlbr.; *Usnea zanthopoga* Nyl.

Since the ANARE station has been occupied several people including **N. R. Laird**, 1948, **N. M. Haysom**, 1949 and **D. A. Brown**, 1956 have made small collections of lichens. These collections were also forwarded to Dodge and a further twenty-four species were described as new to science (Dodge & Rudolph, 1955; Dodge, 1968, 1970):

Bacidia macquariensis Dodge; *Blastenia macquariensis* Dodge; *Caloplaca macquariensis* Dodge; *Catillaria rudolphi* Dodge; *Chiodecton acarosporoides* Dodge; *Chiodecton macquariensis* Dodge; *Kuttlingeria macquariensis* Dodge; *Lecanora brownii* Dodge; *Lecanora procifera* Dodge; *Lecidea haysomi* Dodge; *Lecidea macquariensis* Dodge; *Omphalodina macquariensis* Dodge; *Opegrapha macquariensis* Dodge; *Parmelia brownii* Dodge; *Parmelia haysomi* Dodge; *Parmelia macquariensis* Dodge; *Peltigera lairdi* Dodge; *Phlyctis macquariensis* Dodge; *Phyllopyrenia macquariensis* Dodge; *Physcia macquariensis* Dodge; *Porina macquariensis* Dodge; *Psoroma macquariensis* Dodge; *Squamarina haysomi* Dodge; *Thamnolecania macquariensis* Dodge & Rudolph.

There were also five new records added to the list:

Lecidea subglobulata Knight; *Parmelia turgidula* Bitter; *Placopsis perrugosa* (Nyl.) Nyl.; *Ramalina geniculata* Hook.f. & Tayl.; *Stereocaulon argodes* Nyl.

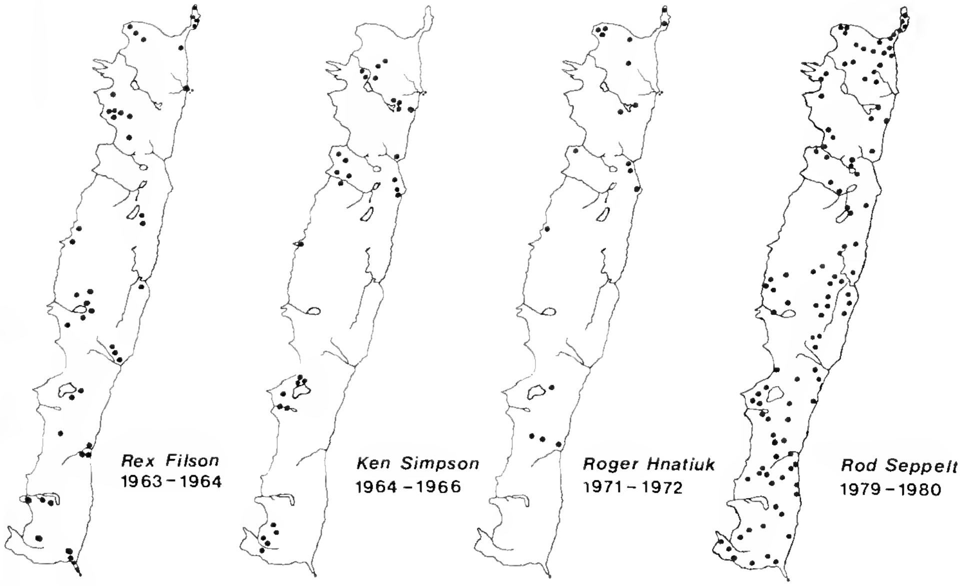

Fig. 3. Collecting sites of the major lichen collectors on Macquarie Island.

From 1963 collecting has been carried out systematically on Macquarie Island. **R. B. Filson** spent one day there in March 1963 and four months from December 1963 to March 1964, collecting extensively all around the island (Fig. 3). **K. S. Simpson** made numerous collections from widely scattered localities during the 16 months from December 1964 to March 1966. **R. J. Hnatiuk** spent December 1971 and January 1972 making comparison studies of alpine grassland regions. He collected 240 samples of lichen from 15 separate localities. **D. A. Parker** collected a number of specimens during 1971 and **R. Waterhouse** collected at the north of the island in 1972.

D. S. Horning was biologist with the Australian Museum Macquarie Island Expedition during the summer of 1977-78. The lichen specimens were determined by D. J. Galloway and the results published by the Museum (Lowry et al., 1978). The following is the list of species not previously reported for the region:

?Argopsis megalospora Th. Fr.; *Cladonia auerii Räs.; C. coniocraea* (Flörke) Spreng.; *C. cornuta* (L.) Hoffm.; *C. fimbriata* (L.) Fr.; *C. foliacea* (Huds.) Willd.; *Endocaena informis*; *Hypogymnia lugubris* (Pers.) Krog.; *Lecanora parmelina* Zahlbr.; *Mastodia tessellata* Hook. & Harv.; *Parmelia* (Pseudoparmelia) *caperata* (Hoffm.) Ach.; *Parmelia cunninghamii* Cromb.; *P. signifera* Nyl.; *Parmelia* (*Hypotrachyna*) *sinuosa* (Sm.) Ach.; *Peltigera horizontalis* (Huds.) Baum.; *P. rufescens* (Weis) Humb.; *Pertusaria dactylina* (Ach.) Nyl.; *Pseudocyphellaria delisea* (Fée in Del.) Gall. & James; *Psoroma hypnorum* (Hoffm.) S. Gray; *Siphulastrum mamillata* [?unpublished ms. name]; *Sphaerophorus globosus* (Huds.) Vain; *S. melanocarpus* (Sw.) DC.; *S. ramulifer* M. Lamb; *Thamnolia vermicularis* (Sw.) Schaer.; *Usnea* (*Neuropogon*) *antarctica* DuReitz; *Usnea glomerata* Mot.; *Usnea* (*Neuropogon*) *laxissima* Dodge; *Xanthoria elegans* (Link.) Th. Fr.

R. D. Seppelt spent a few days during November-December 1975 at Macquarie Island when he collected a few lichen samples. He was again on the Island for the 1979-80 summer period collecting bryophytes and lichens; he collected 197 specimens from 108 localities (Fig. 3).

PRINCIPAL VEGETATION FORMATIONS

The vegetation of Macquarie Island can be divided into five main formations: wet tussock grassland, herbfield, fen, bog and feldmark (Taylor, 1955). Brief notes

Fig. 4. Coastal rock stacks between Bauer Bay and Douglas Point showing abundance of species; dominant lichen is *Parmelia sulcata*. Photo: Ken Simpson.

Fig. 5. View from Mount Law towards Mount Blake (far middle-distance) and Mount Hamilton (left, far distance) showing lichen-covered plateau outcrops (left and right foreground), feldmark skirted by cushions of *Azorella* and *Rhacomitrium* (centre foreground), and plateau herbfield (middle distance). ANARE photo: R. D. Seppelt.

are given below for these, together with the dominant lichen genera occurring in each location.

Wet Tussock Grassland:

The wet tussock grassland is found on all steep coastal slopes to an altitude of about 300 metres, on some inland slopes protected by severe winds and on coastal raised beach terraces, except where there is a high water table. This alliance is dominated by *Poa foliosa* and *Stilbocarpa polaris* with *Polystichum vestitum* and *Poa hamiltonii* as minor components in a few localities. The lichens in this alliance are few and are restricted to the bare earth patches between the tussocks or on rocky outcrops emerging from the grass canopy. On the bare patches of earth *Cladonia*, *Baeomyces* and *Peltigera* can be found associated with debris and roots.

The rock outcrops though not strictly part of the grassland have a wider lichen flora including *Psoroma*, *Cladonia*, *Lecidea*, *Lecanora*, *Usnea*, *Ramalina*, *Hypogymnia* and *Menegazzia*.

The maritime communities have been grouped by Taylor (1955: 49) as a separate association under this alliance. The coastal rocks in the splash zone have a large number of crustose species: *Microthelia*, *Caloplaca*, *Placopsis*, *Lecanora*, and *Lecidea* are common. The old sea stacks, e.g. The Nuggets, have many additional genera, *Menegazzia*, *Peltigera*, *Pseudocyphellaria*, *Parmelia* and *Graphis*. These are mostly found on the sheltered side and top.

The cliffs at the edge of the plateau and the plateau outcrops provide the richest lichen flora on the island. *Usnea*, *Stereocaulon*, *Parmelia*, *Hypogymnia*, *Menegazzia*, *Caloplaca*, *Lecidea*, *Rhizocarpon*, *Lecanora*, *Microthelia* and several other crustose genera grow on these rocky faces which are abundantly covered with lichens.

Herbfield:

The herbfield alliance is found in areas with a relatively high water table and moderate wind exposure at all altitudes up to 350 metres. It is dominated by *Pleurophyllum hookeri*; however the floristic composition varies greatly. In general the lichen flora is scarce; *Baeomyces*, *Psoroma*, *Lecidea*, and *Cladonia* are found recolonising bare patches of soil between the herbfields while the low branchlets of *Coprosma pumila* and other low bushes are the habitat for *Usnea*, *Hypogymnia*, *Cladia*, *Pseudocyphellaria* and *Sphaerophorus*.

Fen:

Juncus scheuchzerioides is the characteristic dominant vascular species of the fen alliance which occures locally in valley bottoms on the plateau and in isolated areas on the raised beach terraces. This alliance is very poor in lichen species; occasional patches of *Psoroma* or *Cladonia* are seen growing on dryer peat patches but in general the areas are too wet for lichen growth.

Bog:

The bog alliance occurs locally at all elevations on the island where there is an acidic water table at or above ground surface level. The lichens here are restricted to elevated and better drained areas within the alliance; *Hypogymnia*, *Usnea*, *Cladonia*, *Cladia*, *Pseudocyphellaria*, *Lecidea* and *Psoroma* are found growing over and amongst mosses and *Colobanthus muscoides*. Species of *Stereocaulon*, *Placopsis*, *Rhizocarpon* and *Lecidea* are common on rocks beside small streams.

Feldmark:

Feldmark is found in all areas subject to high wind velocities at all altitudes and covers the greater part of the island above 180 metres. The dominant lichens are: *Usnea*, *Sphaerophorus*, *Cladonia*, *Cladia*, *Hypogymnia*, *Pseudocyphellaria*, *Lecidea*, *Baeomyces* and *Psoroma*. *Pertusaria* and other crustose genera grow on the

cushions of *Azorella selago*. Moss cushions sometimes provide habitat for small crustose species. Foliose and fruticose species occur amongst the pebbles and gravels of the bare patches on the slopes; here the dominant genera are *Hypogymnia*, *Stereocaulon*, *Lecanora*, *Lecidea*, *Rhizocarpon* and *Placopsis*. Some crustose species assume a fruticose habit because of the harsh environmental conditions. These will be discussed in more detail in later papers when individual genera are considered.

ARTIFICIAL KEY TO THE LICHEN GENERA ON MACQUARIE ISLAND

1. Thallus fruticose or squamulose
    2. Thallus fruticose
        3. Primary thallus granulate crustose
            4. Apothecia sessile
                5. Cephalodia present .... *Placopsis*
                5. Cephalodia absent .... *Aspicilia*
            4. Apothecia terminal on erect podetia .... *Baeomyces*
        3. Primary thallus lacking or not granulate-crustose
            6. Thallus hollow
                7. Primary thallus absent
                    8. Thallus not inflated or lacerate
                        9. Thallus a shade of brown with regular patterns of perforations through the outer walls .... *Cladia*
                        9. Thallus a shade of grey with black markings and without perforations .... *Hypogymnia*
                    8. Thallus much inflated and somewhat lacerate, perforations in walls very irregular; on coastal outcrops .... *Ramalina*
                7. Primary thallus erect and subfoliose, apothecia on cup-shaped pseudopodetia .... *Cladonia*
            6. Thallus solid
                10. Thallus less than 1 cm tall
                    11. Thallus more or less terete, of uniform colouring
                        12. Thallus a shade of white or yellowish-white
                            13. Thallus with cephalodia .... *Stereocaulon*
                            13. Thallus without cephalodia .... *Thamnolecania*
                        12. Thallus a shade of yellow or orange .... *Caloplaca*
                    11. Thallus dorsiventral one side a shade of green or brown, the other pale
                        14. Thallus without cephalodia
                            15. Thallus distinctly isidiose .... *Massalongia*
                            15. Thallus not isidiose .... *Cladonia*
                        14. Thallus with dark coloured cephalodia .... *Psoroma*
                10. Thallus greater than 1 cm tall
                    16. Thallus with central chondroid axis
                        17. Thallus a shade of white, pink or greyish-white with cephalodia .... *Stereocaulon*
                        17. Thallus a shade of yellow, yellow-green or green and black, without cephalodia .... *Usnea*
                    16. Thallus without a central chondroid axis
                        18. Thallus green, yellow-green or brownish green
                            19. Thallus dorsiventral, strap-like
                                20. Thallus with distinct soralia .... *Ramalina*
                                20. Thallus with dorsiventral lobulate branching at the margins .... *Sphaerophorus*
                            19. Thallus forming cups, not strap-like .... *Cladonia*

18. Thallus a shade of white, pink or brownish white
21. Thallus hollow or compactly filled with medulla, lacking cephalodia
22. Thallus hollow with perforations in the axils of the branches .... *Cladonia*
22. Thallus compactly filled with medulla axils not pertorated .... *Sphaerophorus*
21. Thallus with tough chondroid axis, cephalodia pink to pale grey .... *Stereocaulon*
2. Thallus foliose
23. Phycobiont blue-green
24. Thallus gelatenous when wet
25. Phycobiont *Nostoc*
26. Cortex distinctly cellular .... *Leptogium*
26. Cortex of interwoven hyphae .... *Collema*
25. Phycobiont *Xanthocapsa* .... *Thyrea*
24. Thallus not gelatenous when wet
27. Lower surface not veined
28. Thallus lobes small, less than 5 mm wide, margins divided, isidiose, lobulate
29. Apothecia lecanorine, margin prominent .... *Pannaria*
29. Apothecia lecideine, margin disappearing .... *Massalongia*
28. Thallus lobes large, up to 1 cm wide margins entire .... *Erioderma*
27. Lower surface veined .... *Peltigera*
23. Phycobiont green
30. Lower surface smooth shining
31. Thallus hollow
32. Upper surface white to yellowish-white with perforations into the central cavity .... *Menegazzia*
32. Upper surface grey with black markings without perforations *Hypogymnia*
31. Thallus solid
33. Lower surface white .... *Cetraria*
33. Lower surface black .... *Platismatia*
30. Lower surface ecorticate, tomentose or rhizinate
34. Thallus small, less than 10 mm tall, subfruticose
35. Thallus with dark coloured cephalodia .... *Psoroma*
35. Thallus without dark coloured cephalodia .... *Cladonia* (primary thallus)
34. Thallus distinctly foliose
36. Lower surface with rhizines
37. Lower surface black .... *Parmelia*
37. Lower surface pale .... *Physcia*
36. Lower surface tomentose with pseudocyphellae ...... *Pseudocyphellaria*
1. Thallus squamulose or crustose
38. Fruiting body stipitate, on podetia or pseudopodetia
39. Ascospores many per ascus
40. Exciple pale, soft .... *Biatorella*
40. Exciple black, brittle .... *Sarcogyne*
39. Ascospores eight per ascus
41. Thallus crustose, apothecia sessile .... *Icmadophila*
41. Thallus a fine powdery crust, apothecia stipitate .... *Baeomyces*
38. Fruiting body immersed, adnate or sessile
42. Ascospores more than eight per ascus

43. Apothecia adnate or sessile
44. Exciple pale, soft . . . . *Biatorella*
44. Exciple black, brittle . . . . *Sarcogyne*
43. Apothecia immersed . . . . *Acarospora*
42. Ascospores one to eight per ascus
45. Ascospores simple, unilocular
46. Thallus squamulose
47. Phycobiont blue-green
48. Apothecia lecideine . . . . *Parmeliella*
48. Apothecia lecanorine . . . . *Pannaria*
47. Phycobiont green
49. Apothecia sessile to adnate
50. Apothecia lecideine . . . . *Lecidea*
50. Apothecia lecanorine. . . . . *Psoroma*
49. Apothecia immersed . . . . *Trapelia*
46. Thallus crustose
51. Phycobiont green
52. Fruiting body an apothecium
53. Apothecia immersed in thallus or in warts
54. Apothecia immersed but not in warts
55. Paraphyses unbranched. . . . . *Aspicilia*
55. Paraphyses branched and anastomosing . . . *Trapelia*
54. Apothecia immersed in thalline warts . . . . *Pertusaria*
53. Apothecia adnate to sessile
56. Disk of apothecium K− or K+ but not K+ purple
57. Apothecia lecanorine
58. Thallus with cephalodia . . . . *Placopsis*
58. Thallus without cephalodia. . . . . *Lecanora*
57. Apothecia lecideine . . . . *Lecidea*
56. Disk of apothecium K+ purple . . . . *Caloplaca*
52. Fruiting body a perithecium . . . . *Verrucaria*
51. Phycobiont blue green . . . . *Pyrenopsidium*
45. Ascospores septate or polaribilocular
59. Fruiting body a perithecium or perithecium-like
60. Ascospores many-celled
61. Ascospores transversely septate only
62. Fruiting bodies immersed in stromatic warts . . . . *Trypethelium*
62. Fruiting bodies not immersed in stromatic warts . *Arthopyrenia*
61. Ascospores transversely and longitudinally septate
63. Ascospores hyaline . . . . *Polyblastiopsis*
63. Ascospores brown . . . . *Anthracothecium*
60. Ascospores two-celled. . . . . *Microthelia*
59. Fruiting body not perithecial
64. Fruiting body round or misshapen by pressure
65. Ascospores hyaline
66. Apothecia lecanorine
67. Ascospores polaribilocular . . . . *Caloplaca*
67. Ascospore walls not thickened . . . . *Icmadophila*
66. Apothecia lecideine
68. Ascospores polaribilocular, two-celled
69. Ascospore walls not thickened

70. Thallus crustose
71. Apothecial disk pale to dark not orange
72. Apothecia less than 1 mm diam .... *Catillaria*
72. Apothecia greater than 1 mm diam .... *Icmadophila*
71. Apothecial disk yellow to orange .... *Dimerella*
70. Thallus squamulose .... *Toninia*
69. Ascospores polaribilocular .... *Blastenia*
68. Ascospores more than two-celled
73. Ascospores transversely and longitudinally septate
74. Apothecia black, ascospores grey to brown to black .... *Rhizocarpon*
74. Apothecia yellow or pale, ascospores hyaline .... *Bombyliospora*
73. Ascospores transversely septate only .... *Bacidia*
65. Ascospores brown
75. Ascospores transversely septate only
76. Apothecia lecideine .... *Buellia*
76. Apothecia lecanorine .... *Rinodina*
75. Ascospores transversely and longitudinally septate
77. Apothecia immersed in the thallus or lecano rine .... *Diploschistes*
77. Apothecia adnate to sessile, lecideine ...... *Rhizocarpon*
64. Fruiting body elongate, irregular or star-shaped
78. Ascospores transversely septate only
79. Ascospores brown
80. Ascospores two-celled .... *Melaspilea*
80. Ascospores more than two-celled .... *Phaeographis*
79. Ascospores hyaline
81. Fruiting bodies clustered, immersed in stroma
82. Hypothecium dark .... *Chiodecton*
82. Hypothecium pale .... *Enterographa*
81. Fruiting bodies single not immersed in stroma
83. Paraphyses branched and anastomosing, exciple usually well developed
84. Ascospores usually two- to four-celled, cells of unequal size .... *Arthonia*
84. Ascospores usually four or more celled, cells uniform .... *Opegrapha*
83. Paraphyses unbranched, exciple well developed .... *Graphis*
78. Ascospores transversely and longitudinally septate
85. Ascospores hyaline
86. Paraphyses branched and anastomosing ... *Arthothelium*
86. Paraphyses unbranched .... *Graphina*
85. Ascospores brown .... *Phaeographis*

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STUDIES ON MACQUARIE ISLAND LICHENS 2: THE GENERA HYPOGYMNIA, MENEGAZZIA, PARMELIA AND PSEUDOCYPHELLARIA

by

REX B. FILSON*

SUMMARY

The genera *Hypogymnia* and *Menegazzia* (Hypogymniaceae), *Parmelia* (Parmeliaceae) and *Pseudocyphellaria* (Lobariaceae) are enumerated. Two new species, *Parmelia lusitaniensis* R. Filson and *Parmelia phillipsiana* R. Filson, are described. Keys to species and varieties are given where applicable. A full description of each species is provided, together with discussion on affinities, chemical constituents and distribution.

HYPOGYMNIA

Hypogymnia lugubris (Pers.) Krog, *Norsk Polarinst. Skr.* 144: 99 (1968).
Parmelia lugubris Pers. in Gaudich., *Voy. Uranie Bot.*, 196 (1828).

Thallus foliose or subfruticose, loosely attached to substrate, sometimes firmly held within moss cushions, pale grey with black lines and occasional black patches; *lobes* up to 3 mm wide, dichotomously or irregularly branched, sparsely imbricate; *upper surface* mat to shining, strongly wrinkled, without rhizines. *Apothecia* stipitate, up to 5 mm diam.; *margin* very thin, crenulate becoming lacerate; *disk* reddish-brown, shining, deeply concave at first becoming almost flat at maturity; *hypothecium* hyaline; *hymenium* up to 45 μm tall; *paraphyses* 2 μm diam., apical cell expanded to 5 μm; *asci* 8-spored, 30-36 × 12-16 μm; *ascospores* hyaline, ellipsoidal, simple, 8-9 × 5-6 μm. *Pycnidia* not seen.

REACTIONS: Cortex K+ yellow; medulla K−, C−, KC+ red, P+ red.

CHEMISTRY: Atranorin, chloroatranorin, physodic acid, physodalic acid.

REPRESENTATIVE SPECIMENS EXAMINED (total seen 54, Fig. 7):

Hurd Point, *R. Filson 6014 & P. Atkinson*, 11.ii.1964 (MEL 1022202); 1.5 km north-west of Waterfall Bay, *R. Filson 5759 & N. Barrett*, 22.i.1964 (MEL 1022207); 1 km north of Aurora Point, *R. Filson 6187 & R. Petersen*, 20.ii.1964 (MEL 1022197); Half-way along the west side of Gratitude Lake, *R. Filson 5933 & J. Phillips*, 4.ii.1964 (MEL 1022201); North end of Plateau, *N. Haysom Z61*, 8.ii.1950 (MEL 7720); North of Mount Gwynn, *R. Hnatiuk 11584*, 30.xii.1971 (MEL 1024296); Featherbed flats, *N. R. Laird*, 1948 (MEL 7719); Mount Aurora, *D. A. Parker*, 12.x.1971 (MEL 1023740); Summit of Mount Elder, *K. Simpson B28*, 2.viii.1965 (MEL 26014); 500 metres south-west of Pyramid Peak, *R. D. Seppelt 9945*, 4.ii.1980 (MEL 1029361).

DISCUSSION:

Hypogymnia lugubris is one of the commonest lichens on Macquarie Island. It occurs both on the coastal fringe almost at sea level and on the mountains. In coastal habitats it grows amongst grasses, over small bushes and in crevices between rocks. It may be found in both exposed and sheltered aspects, from dry peaty areas on the featherbed to tops of the rock stacks. On the plateau it is common amongst grasses, it forms part of the cushions of *Azorella* and *Colobanthus* and also grows on bare rock.

This species is very polymorphic. Field observations indicate that the varieties

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Muelleria 4(4): 317-331 (1981).

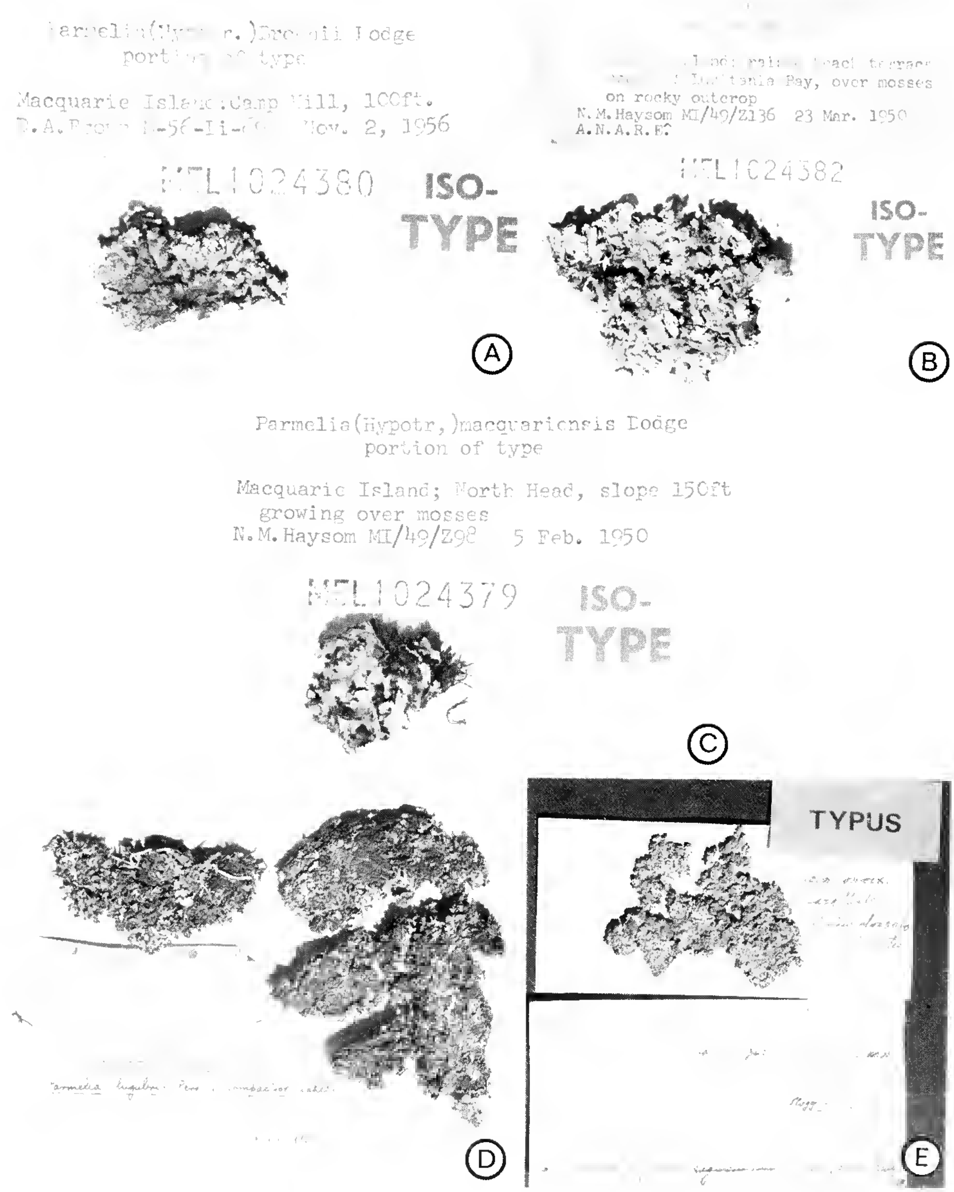

Fig. 1. a—isotype of *Parmelia brownii;* b—isotype of *Parmelia haysomii;* c—isotype of *Parmelia macquariensis;* d—isolectotype of *Parmelia lugubris* f. *compactior;* e—holotype of *Parmelia physodes* var. *compacta.*

lugubris, *compacta* and *sublugubris* keyed below are so variable that it is very difficult to obtain firm divisions between them.

KEY TO VARIETIES:

1. Thallus lobes densely branched; upper surface always with black markings

2. Thallus lobe apices generally brown, upper surface with sparse black markings .... *H. lugubris* var. *compacta*

2. Thallus lobe apices rarely brown, upper surface with prominent black markings .... *H. lugubris* var. *sublugubris*

1. Thallus lobes loosely branched, elongate; upper surface occasionally black marked .... *H. lugubris* var. *lugubris*

var. **lugubris**

Thallus foliose, loosely attached to the substrate; *lobes* elongate, hardly imbricate, loosely branched.

var. **compacta** (Müll. Arg.) Dodge, Lichen Flora of the Antarctic Continent and Adjacent Islands, 205 (1973).

Parmelia physodes var. *compacta* Müll. Arg., *Nuovo G. Bot. ital.* 21: 39 (1889).

Type: Hogget Bay, Fuegiae, *C. Spegazzini* 1885 (G!) (Fig. 1E).

Hypogymnia lugubris var. *compactior* (Zahlbr.) Elix, *Brunonia* 2: 203 (1980).

Parmelia lugubris f. *compactior* Zahlbr. *Denkschr. Akad. Wiss., Wien*, 104: 110 (1941).

Type: Mount Pisgah, Central Otago *J. S. Thomson 1477 (ZA215).* (W. lectotype; CHR! isolectotype). (Fig. 1D).

Thallus similar to var. *lugubris* differing in the imbricate, more crowded, irregularly branched lobes which are occasionally subfruticose, the *upper surface* consistently black marked and the ends of the lobes generally brown.

var. **sublugubris** (Müll. Arg.) Elix, *Brunonia* 2: 207 (1979).

Parmelia physodes var. *sublugubris* Müll. Arg., *Flora, Jena* 66: 75 (1883).

Parmelia sublugubris (Müll. Arg.) Dodge, *B.A.N.Z. Antarct. Res. Exped. 1929-1931 Rep. ser. B. Zool.-Bot.* 7: 188 (1948).

Thallus similar to var. *lugubris*, differing in being densely dichotomous with more prominent black markings or sometimes wholly blackened.

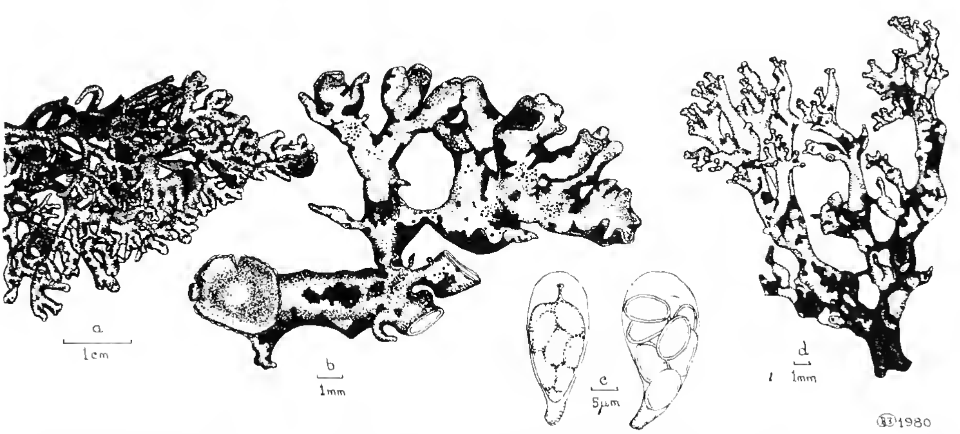

Fig. 2. *Hypogymnia lugubris*. a—habit of foliose form collected 500 m SW of Pyramid Peak; b—single lobe of same showing apothecium; c—asci and ascospores (a-c, MEL 1029361); d—lobe of fruticose form (var.*compacta*) collected at northern tip of Douglas Point (MEL 1022204).

MENEGAZZIA

Menegazzia sanguinascens (Räs.) R. Sant., *Ark. Bot.* 30A(11): 28(1942).

Parmelia sanguinascens Räs., *Suomal. elain-ja kasvit. Seur. van. Julk.* 2 (1): 18 (1932).

Menegazzia circumsorediata sensu Dodge & Rudolph, *Ann. Mo. bot. Gdn.* 42: 142 (1955) non R. Sant. *Ark. Bot.* 30A(11): 14(1942).

Thallus foliose, saxicolous or corticolous, tightly appressed to the substrate, forming rosettes up to 10 cm diam.; *lobes* convex, margin rotund, up to 2 mm wide, hardly imbricate, perforate; perforations irregularly scattered; *upper surface* smooth or wrinkled, dull or slightly shining, whitish-grey to grey, sometimes blackening towards the centre, sorediose; soredia granular, concolourous with the thallus, or sometimes becoming grey, forming soralia up to 2 mm diam., originating from laminal globose pustules which eventually burst forming an opening into the central cavity, sometimes the centre of the thallus becomes a sorediose mat; *lower surface* black, dull to shining, strongly wrinkled; *medulla* compact, white in the upper parts blackening towards the central cavity; central cavity lined with a black medulla which becomes white or grey at the extreme lobe ends. *Apothecia* sessile or shortly stipitate up to 3 mm diam.; *margin* at first smooth and inrolled, becoming rugulose, later becoming sorediate, eventually completely dissolving in soredia; *disk* reddish-brown, concave, shining; *hypothecium* 30 μm thick in the centre of the apothecium; *hymenium* up to 150 μm tall; *asci* 93-105 $\times$ 36 μm; *ascospores* 39-54 $\times$ 24-30 μm, up to 8 per ascus of which only one or two mature, simple, hyaline ellipsoidal.

Reactions: Thallus K + yellow, P − or P + pale yellow; medulla K + yellow becoming red, P + orange; soredia K + yellow becoming orange.

Chemistry: Stictic, peristictic acids and atranorin.

Representative Specimens Examined (total seen 34, Fig. 7):

Handspike Point, on rock outcrop at the end of the point, *R. Filson 6315 & P. Atkinson*, 11.iii.1964 (MEL 1023845); Hurd Point, about 2/3 distance out onto the peninsula, *R. Filson 6002 & P. Atkinson*, 10.ii.1964 (MEL 1024216); Coastal rocks north of Lusitania Bay, *N. Haysom*, 23.iii.1950 (MEL 7710); Mount Hamilton North, *R. Hnatiuk 11552*, 29.xii.1971 (MEL 1024283); North Head, radio mast, *N. R. Laird*, 7.ix.1948 (MEL 7715); North side of Square Lake, *R. D. Seppelt 6081*, 23.xi.1979 (MEL 1029373); Mouth of Flat Creek on side of rock stack c. 20-40 m north-east of beach, *K. Simpson E26*, 18.xi.1966 (MEL 1000282); Caroline Cove, c. 500 m inland between north and south arms of Caroline Creek, *K. Simpson E58*, 18.i.1966 (MEL 26007).

Discussion:

This species was first described from Tierra del Fuego by Räsänen and later reported from Juan Fernandez, Chile, Patagonia (Santesson 1942: 29), South Georgia (Lindsay 1973: 108, 1974: 35) and New Zealand (Martin 1966: 147). Early collections of this species were previously determined as *M. circumsorediata* R. Sant. by Dodge but that species differs from *M. sanguinascens* in the development of

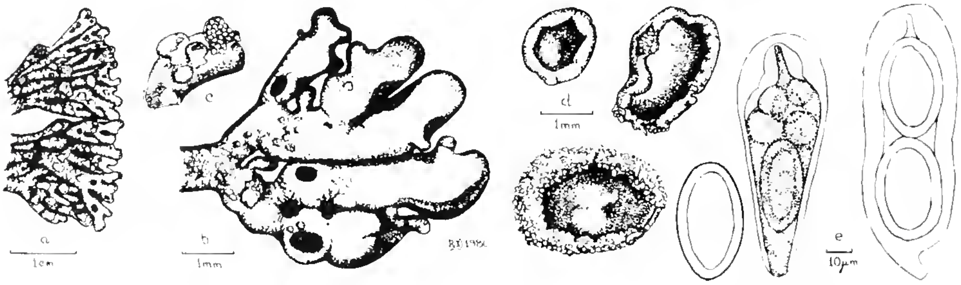

Fig. 3. *Menegazzia sanguinascens*. a—habit; b—marginal lobe; c—portion of lobe showing development of globose soralia; d—three stages in development of soredia on the apothecia; e—development of ascospores within the ascus, one mature spore on left. All from specimen collected 1 km north of Aurora Point, *R. Filson 6185 & R. Petersen*, 20.ii.1964, MEL 1023845.

the soredia. In *M. circumsorediata* the soredia develop around the margins of the perforations whilst in *M. sanguinascens* they develop from independent laminal pustules. Santesson (1942: 31) describes this species as occurring in the Fuegian forests and shrublands where it is corticolous in the densest *Chiliotrichum* communities. Lindsay (1973: 109) says that in South Georgia it occurs on rock and over *Colobanthus* cushions at low altitudes near the shore in non-enriched habitats. On Macquarie Island it occurs on rocks near the shore and on the seaward side of outcrops at the edge of the plateau, over moss and *Colobanthus* cushions on the rocky outcrops in the featherbed, and on wood, i.e. the old radio mast which was erected by Sir Douglas Mawson in 1930 on North Head.

PARMELIA

1. Thallus with soredia or isidia
    2. Thallus sorediose
        3. Thallus pustulate sorediose
            4. Thallus yellow green .... *P. haysomii*
            4. Thallus pale grey to mineral grey .... *P. labrosa*
        3. Thallus not pustulate sorediose
            5. Soredia laminal
                6. Undersurface black with brown zone at margins of lobes, upper surface not reticulately ridged or pseudocyphellate
                    7. Upper surface wrinkled, not pruinose, medulla K− .... *P. texana*
                    7. Upper surface dull, smooth, pruinose, medulla K+ .... *P. lusitaniensis*
                6. Undersurface black to margin, upper surface reticulately ridged becoming pseudocyphellate and sorediose .... *P. sulcata*
            5. Soredia marginal capitate
                8. Lobes >3 mm wide, soralia labriform .... *P. macquariensis*
                8. Lobes <3 mm wide, soralia pulvinate .... *P. brevirhiza*
    2. Thallus isidiose
        9. Thallus green to yellow-green .... *P. phillipsiana*
        9. Thallus brown to greenish-brown .... *P. waiporensis*
1. Thallus without soredia or isidia .... *P. signifera*

Parmelia brevirhiza Kurok., *Contr. U. S. natn. Herb.* 36: 166(1964).

Hypotrachyna brevirhiza (Kurok.) Hale, *Smithson. Contr. Bot.* 25: 26(1975)

Type: Chile, Isla Riesco, Mina Elena, Terr. Magallanes. *R. Santesson 2066*, 29.iv.1940 (S).

Thallus foliose, saxicolous or muscicolous, loosely attached to the substrate, pale grey to mineral grey, ends of the lobes becoming dark grey; *lobes* dichotomous, truncate at the apices, up to 1 mm wide and 3 mm long, marginal lobes becoming erect, without cilia; *upper surface* smooth, dull to slightly shining, maculate in part; upright ends of the lobes becoming soraliate, finally forming a large capitate, pulvinate soralium; *lower surface* jet black with a bare brown zone at the ends of non-soraliate lobes, densely rhizinate; rhizines simple or strongly dichotomous; *medulla* white. *Apothecia* not seen.

Reactions: Thallus K+ yellow; medulla K+ yellow becoming red, C−, KC−, P+ orange.

Chemistry: Atranorin, salacinic acid.

Specimen Examined (Fig. 7):

Handspike Corner, *R. D. Seppelt 9344*, 1.i.1980 (MEL 1029371).

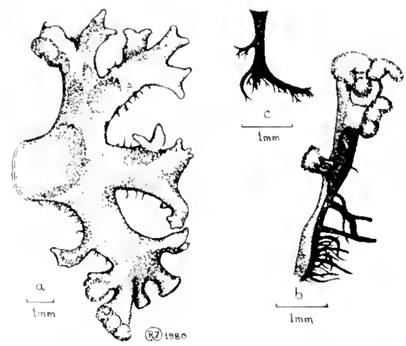

Fig. 4. *Parmelia brevirhiza*. a—marginal lobe showing habit; b—lobe showing capitate, pulvinate soralia; c—dichotomous, fasciculate rhizine. All from MEL 1029371.

DISCUSSION:

This species is distinguished by the long narrow lobes with capitate, pulvinate soralia.

Parmelia haysomii Dodge, *Nova Hedwigia* 15: 293(1968) [as '*P. haysomi*'].

Type: Macquarie Island, raised beach terrace south of Lusitania Bay, over mosses on rocky outcrop, *N. M. Haysom Z136*, 23.iii.1950 (holotype, herb. Dodge; isotype! MEL 1024382) (Fig. 1B).

Thallus foliose, loosely to moderately attached to the substrate, pale straw-coloured to light yellow-green, up to 15 cm diam.; *lobes* irregular, rotund at the apices, up to 3 mm wide, strongly imbricate, secondary lobes sometimes building up the thallus into a mat, without cilia; *upper surface* dull to slightly shining, without isidia, smooth at the margins, becoming pustulate towards the centre; pustules sometimes bursting to form granular soredia; *under surface* jet black with pale brown zone at the margins of the lobes, sparsely rhizinate; rhizines black in the centre of the thallus sometimes becoming pale towards the margins; *medulla* white. *Apothecia* not seen.

REACTIONS: Thallus K–; medulla K–, C–, KC–, P+ orange-red.

CHEMISTRY: Usnic, protocetraric and caperatic acids.

REPRESENTATIVE SPECIMENS EXAMINED (total seen 12, Fig. 7):

Outcrops on beach at north-eastern corner of Cape Star, *R. Filson 6065 & P. Atkinson*, 12.ii.1964 (MEL 34972); Outcrops in featherbed c. 1 km north of Aurora Point, *R. Filson 6186 & R. Petersen*, 20.ii.1964 (MEL 34973); Raised beach terrace south of Lusitania Bay, *N. M. Haysom Z136*, 23.iii.1950 (MEL 1024382); Handspike Corner, on rock stack, *R. D. Seppelt 7339*, 1.i.1980 (MEL 1029366); Coastal cliffs 1 km north-east of Mount Jeffreys, *R. D. Seppelt 7506*, 17.i.1980 (MEL 1026484).

DISCUSSION:

Parmelia haysomii is a common species in New Zealand and Australia. It is closely related to *Parmelia caperata* (L.) Ach., with which it is often confused, but differs in the more yellow-green appearance, the smaller lobes and the persistent pustules which only sometimes burst to form soredia.

On Macquarie Island it occurs mostly over mosses or on bare rock on the rock stacks in the featherbed and on the adjacent cliffs.

Parmelia labrosa (Zahlbr.) Hale, *J. Jap. Bot.* 43: 325(1968).

Parmelia tenuirima var. *labrosa* Zahlbr. *Denskschr. Akad. Wiss., Wien* 104: 356 (1941).

Pseudoparmelia labrosa (Zahlbr.) Hale, *Phytologia* 29: 190(1974).

Thallus foliose, saxicolous, closely appressed to the substrate, pale grey to mineral grey, becoming darker or brownish-grey at the lobe ends; *lobes* rotund at the apices, up to 3 mm wide, imbricate, without cilia; *upper surface* shining, smooth to wrinkled, maculate, without isidia, sorediate; soredia originating from pustules, becoming pustular soraliate on the ridges and margins of the thallus; *lower surface* jet black, with dark brown, bare zone at the margins of the lobes, rhizinate; rhizines simple or dichotomous; *medulla* white. *Apothecia* not seen.

REACTIONS: Thallus K+ yellow; medulla K−, C+ red, KC+ red, P−.

CHEMISTRY: Lecanoric acid, atranorin.

SPECIMENS EXAMINED (Fig. 7):

In small gorge 500 m east of Bauer Bay hut, on cliffs at edge of creek, *R. D. Seppelt 9733*, 8.i.1980 (MEL 1029370); Sandell Bay, *R. D. Seppelt 9883*, 4.ii.1980 (MEL 1029372).

DISCUSSION:

Parmelia labrosa differs from the other small-lobed grey *Parmelia* species in that the soredia originate from pustules, which eventually form pustulate soralia. It is the only *Parmelia* species as yet found on Macquarie Island which reacts C+ red, containing lecanoric acid.

Parmelia lusitaniensis R. Filson sp. nov.

Thallus in substrato modice adhaerens, saxicolous et muscicolous; superficies superior laevis, pruinosa, sorediata, sorediis granularibus, soralia tandem pulvinata, insida et cilia nulla, medulla alba; superficies inferior nigra. Thallus atranorinum et acidum salacinicum continens.

HOLOTYPE: Lusitania Bay, Macquarie Island, *Rex Filson 5975 & Philip Atkinson*, 10.ii.1964 (MEL 1023837).

Thallus foliose, saxicolous and muscicolous, loosely attached to the substrate, forming rosettes up to 4.5 cm diam., pale buff to greyish-buff, becoming darker on older parts of the thallus; *lobes* rotund, crisped, imbricate, up to 6 mm wide, without cilia; *upper surface* dull, smooth, pruinose, without isidia, sorediose; soredia granular, laminal, developing from soralia to large pulvinate clumps; sometimes small colonies appear to be esorediose; *lower surface* jet black with a broad dark brown zone at the lobe ends; rhizines thick, black, simple or dichotomous; *medulla* white. *Apothecia* not seen.

REACTIONS: Thallus K+ yellow; medulla K+ yellow becoming brownish orange, C−, KC−, P+ golden orange.

CHEMISTRY: Salacinic acid, atranorin.

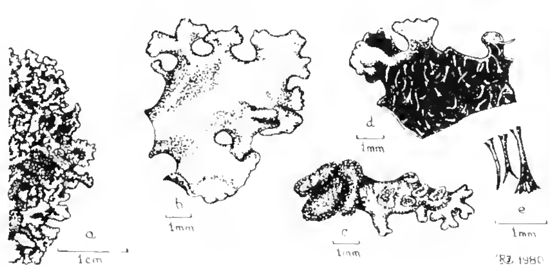

Fig. 5. *Parmelia lusitaniensis*. a—portion of thallus showing habit; b—marginal lobe; c—lobe showing pustular formation of soralia; d—undersurface; e—simple, dichotomous and fasciculate rhizines from the undersurface. All from holotype.

DISCUSSION:

The species is known only from the type collection.

Morphologically *Parmelia lusitaniensis* is very similar to *P. texana* differing in the upper surface being smooth, less sorediate and becoming pruinose at the lobe ends. It can easily be separated from *P. texana* by the chemical reaction of KOH on the medulla.

Parmelia macquariensis Dodge, *Nova Hedwigia* 19: 450(1970).

Type: Macquarie Island, North Head, slope 150 ft, growing over mosses, *N. M. Haysom Z98*, 5.ii.1950 (holotype, herb. Dodge; isotype! MEL 1024379) (Fig. 1C).

Thallus foliose, loosely to moderately attached to the substrate, pale whitish-grey to buff; *lobes* irregularly rotund, up to 12 mm wide, margins crenulate, slightly imbricate, ciliate; cilia black, simple, up to 1 mm long; *upper surface* dull, smooth at margins, becoming rugulose and cracked towards the centre, finely maculate, sometimes pruinose, without isidia, sorediate; soralia marginal, labriform, becoming dark grey to blackish-grey; *lower surface* black, shining, wrinkled, rhizinate; rhizines black, simple or dichotomous; margins bare, dark brown; *medulla* white. *Apothecia* not seen.

REACTIONS: Thallus K+ yellow; medulla K+ yellow becoming red to dirty brown, C−, KC−, P+ orange.

CHEMISTRY: Salacinic acid, atranorin.

REPRESENTATIVE SPECIMENS EXAMINED (total seen 13, Fig. 7):

2 km north of Bauer Bay, on rock outcrops c. 6 m above the featherbed, *R. Filson 5838*, 28.i.1964 (MEL 34976); Outcrops in the featherbed 1 km north of Aurora Point, *R. Filson 6189 & R. Petersen*, 20.ii.1964 (MEL 1024222); Coastal cliffs 1 km south-east of Mount Aurora, *R. D. Seppelt 7507*, 16.i. 1980 (MEL 1026483); Camp Hill, Isthmus, *K. Simpson E94*, 19. iii. 1966 (MEL 1000276).

DISCUSSION:

This species appears at first to be related to *Parmelia reticulata* Tayl.; however, the maculae are not reticulately arranged and they do not develop into pseudocyphellae. The rhizines are simple or dichotomous whereas those of *P. reticulata* are squarrosely branched.

Parmelia phillipsiana R. Filson sp. nov.

Thallus arcte adnatus, saxicolus; superficies superior laevis, isidiata, isidiis cylindricis, ramosisque, coralloidibus, usque ad 2 mm longis, medulla alba; superficies inferior fusca ad centrum thalli nigrescens. Thallus acida continens: usnicum, sticticum, consticticum et norsticticum (vix adest).

Holotype: Cliffs on the western side of Macquarie island, c. 1 km south of Double Point, *R. Filson 5904 & J. Phillips*, 3.ii.1964 (MEL 1024224).

Thallus foliose, closely adnate to the substrate, up to 6 cm diam., pale yellowish-green with narrow brownish-black zone at the lobe margins; *lobes* narrow, rotund at the apices, 0.5 to 1 mm wide, contiguous, without cilia; *upper surface* smooth, slightly shining, sparsely maculate, without soredia, densely isidiate; isidia cylindrical, coralloid, small and simple near the margins, becoming taller (up to 2 mm) and branched towards the centre; *lower surface* dark brown to black with sparse simple rhizines right to the margins of lobes; *medulla* white. *Apothecia* not seen.

REACTIONS: Medulla K+ pale yellow, C−, KC−, P+ brick-red.

CHEMISTRY: Stictic, constictic, usnic acids, trace of norstictic acid.

SPECIMEN EXAMINED (Fig. 7):

Northwest of Handspike Corner, *R. D. Seppelt 7361*, 1.i.1980 (MEL 1029375).

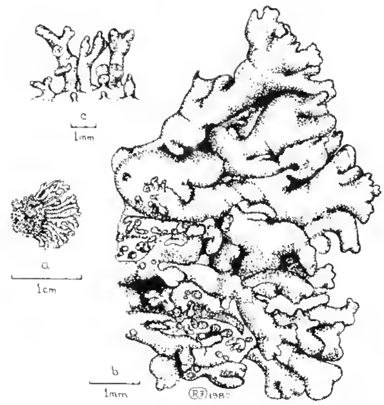

Fig. 6. *Parmelia phillipsiana*. a—portion of thallus showing habit; b—marginal lobes; c—isidia. All from holotype.

DISCUSSION:

Only two yellow-green species of *Parmelia* have been collected on Macquarie Island, *P. phillipsiana* and *P. haysomii*. *P. haysomii* is distinguished by its wide lobes and pustulate soredia and negative reaction of KOH on the medulla. *P. phillipsiana* is sparsely isidiose at the margins becoming densely isidiose in the centre of the thallus and reacts K + pale yellow on the medulla. This species is similar to the Australian species *Parmelia mougeotina* Nyl. but differs from this species in having shorter more convex, contiguous lobes and tall dense coralloid isidia.

Parmelia signifera Nyl. *Lich. Nov. Zel.*, 25(1888)

Thallus foliose, saxicolous, loosely attached to the substratum, pale brown to olive-grey becoming more brown at the lobe ends; *lobes* irregular, rotund at the apices, up to 10 mm wide, strongly imbricate, without cilia; secondary lobes building up the thallus into a thick mat; *upper surface* dull, flat, without soredia or isidia, heavily pseudocyphellate; pseudocyphellae never forming soredia; *lower surface* jet black with a brown zone at lobe ends; centre of thallus densely rhizinate with rhizines right to margins of lobes; rhizines simple or squarrosely branched; *medulla* white. *Apothecia* not seen.

REACTIONS: Thallus K + yellow; medulla K + yellow becoming red to blackish-red, C −, KC −, P + yellow becoming orange.

CHEMISTRY: Atranorin, salacinic acid.

SPECIMENS EXAMINED (Fig. 7):

Mount Haswell, *R. Filson 6025 & P. Atkinson*, 12.ii.1964 (MEL 30249); Featherbed Terrace, off north-western slopes of plateau, *N. Laird*, 1948 (MEL 7736).

DISCUSSION:

This species has only been recorded twice on the island, from the extreme north on the featherbed near Handspike Corner and from the northern slopes of Mount Haswell at the south end. It most certainly should occur between these two localities. *P. signifera* occurs frequently in Australia and New Zealand where it is often found with apothecia; neither of the Macquarie Island specimens are fertile.

Parmelia sulcata Tayl. apud Mack., *Fl. Hibern.* 2: 145(1836).

Parmelia brownii Dodge, *Nova Hedwigia* 19: 449(1970).

Type: Macquarie Island, Camp Hill, 100 ft., *D. A. Brown 69*, 2.xi. 1956 (holotype herb. Dodge; isotype! MEL 1024380) (Fig. 1A).

Thallus foliose, saxicolous and muscicolous, loosely to moderately attached to the substrate, forming patches up to 60 mm diam., pale brownish-buff to olive-grey with darker brown band at the lobe ends; *lobes* irregular, rotund at the apices, up to 6 mm wide, contiguous, sometimes slightly imbricate, without cilia; *upper surface* dull to slightly shining, without isidia, reticulately ridged; ridges becoming maculate then pseudocyphellate; pseudocyphellae finally bursting and then becoming sorediate; *lower surface* jet black right to the margin of lobes, dull to slightly shining, densely rhizinate right to margin of lobes; rhizines black, simple or dichotomous; *medulla* white. *Apothecia* not seen.

Reactions: Thallus K + yellow; medulla K + yellow becoming blood-red to black, C −, KC −, P + orange.

Chemistry: Atranorin, salacinic acid.

Specimens Examined (Fig. 7):
Outcrop in the featherbed 2 km north of Bauer Bay, *R. Filson 5822*, 28.i.1964 (MEL 1024221); Outcrop in the featherbed 1 km north of Aurora Point, *R. Filson 6186a & R. Petersen*, 20.ii.1964 (MEL 1023838); Nuggets Point, *R. Filson 6347, & R. Petersen,* 18.iii.1964 (MEL 1023846); Featherbed terrace, north end of the island, *N. R. Laird*, 20.viii.1948 (MEL 7728).

Discussion:
Parmelia sulcata is a very distinctive lichen which forms large patches on rock on the coastal rock stacks. The lobes are covered in deeply cracked pseudocyphellae which soon become sorediate and then distorted.

Parmelia texana Tuck., *Amer. J. Sci. Arts* ser. 2, 25:424 (1858)
Pseudoparmelia texana (Tuck.) Hale, *Phytologia* 29:191 (1974).

Thallus foliose, saxicolous and muscicolous, loosely to moderately attached to the substrate, forming small patches up to 10 cm diam., pale greyish-white to buff, margins and lobe-ends darker; *lobes* irregularly rotund at the apices, up to 6 mm wide, slightly imbricate, without cilia; *upper surface* dull to slightly shining, without isidia, smooth to wrinkled; wrinkles becoming sorediate; soredia coarse, granular, laminal, sometimes covering the centre of the thallus; *lower surface* jet black, with a very narrow brown zone at the lobe ends; rhizines black or pale, simple; *medulla* white. *Apothecia* not seen.

Reactions: Thallus K + yellow; medulla K −, C + rose-red, KC + rose-red, P −.

Chemistry: Divaricatic acid, atranorin.

Specimens Examined (Fig. 7):
Lusitania Bay, *R. Filson 5974 & P. Atkinson*, 10.ii.1964 (MEL 1024218); Gadgets Gully, *R. Filson 6361 & R. Petersen*, 18.iii. 1964 (MEL 1023847).

Discussion:
Parmelia texana may be confused with both *P. suicata* and *P. lusitaniensis*, but it may be separated from both of these species in being far more sorediose and in the negative reaction of KOH on the medulla. The upper surface never becomes pseudocyphellate as does *P. sulcata*. It differs from *P. lusitaniensis* in having a wrinkled upper surface which soon becomes sorediose while the ends of the lobes never become pruinose.

Parmelia waiporiensis Hillm., *Reprium nov. Spec. Regni veg.* 45: 173(1938).
Neofuscelia waiporiensis (Hillm.) Essl., *Mycotaxon* 7: 53 (1978).

Thallus foliose, saxicolous, closely appressed to the substrate, yellowish-brown

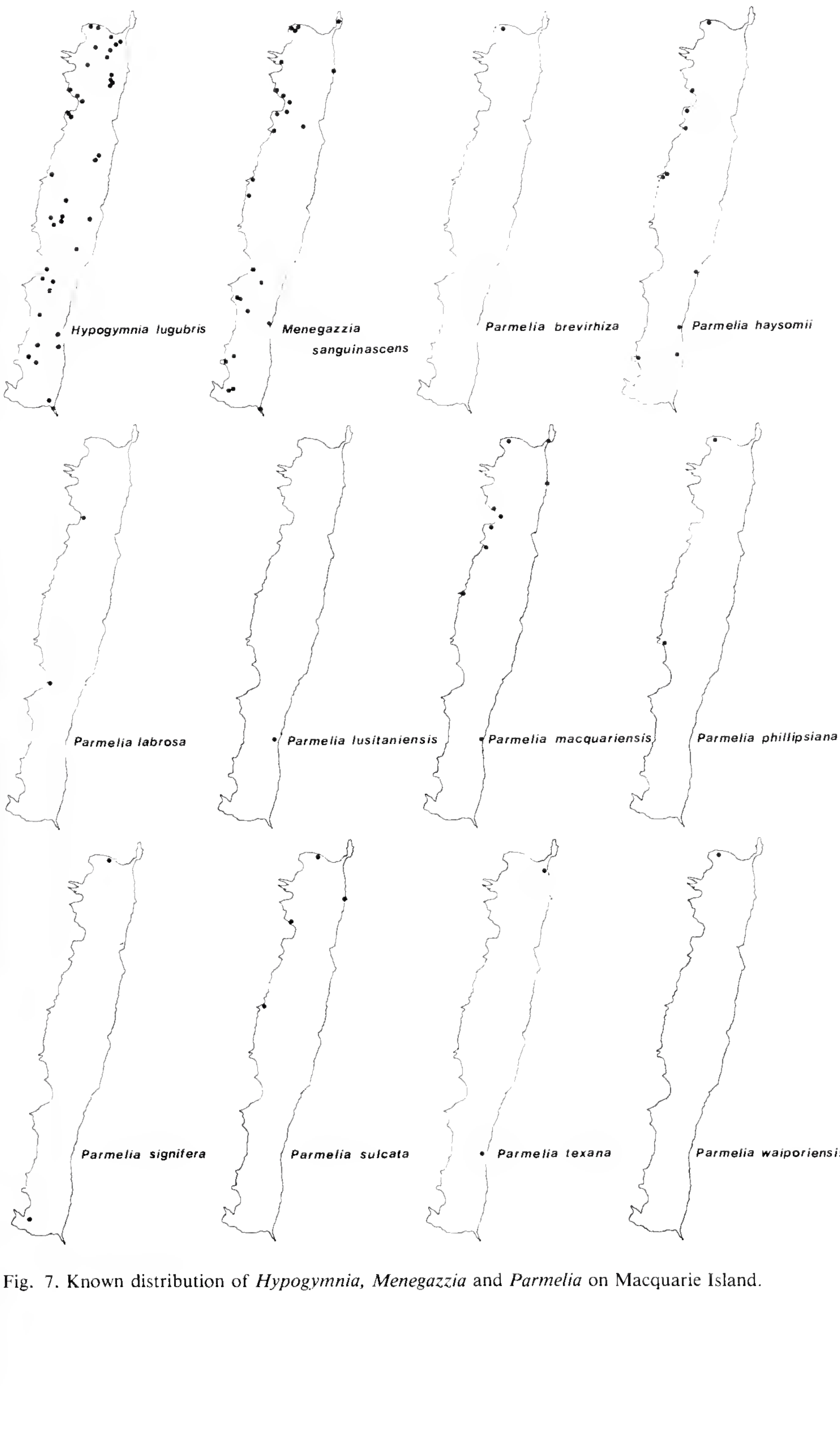

Fig. 7. Known distribution of *Hypogymnia, Menegazzia* and *Parmelia* on Macquarie Island.

to greenish-brown to dark brown; *lobes* short and rounded, up to 3 mm wide, strongly imbricate, without cilia; *upper surface* smooth to wrinkled, dull to slightly shining, without soredia, isidiate; isidia inflated, globular, pustular, forming pulvinate patches in centre of thallus; *lower surface* black, dull to slightly shining, with a smooth dark brown zone at the lobe ends, moderately rhizinate; rhizines black, simple. *Apothecia* not seen.

REACTIONS: Thallus HNO_3+ dark blue-green; medulla K−, C−, KC+ rose-red, P−.

CHEMISTRY: glomelliferic, glomellic, loxodellic acids.

SPECIMEN EXAMINED (Fig. 7):

North-west of Handspike Corner, 50 m from sea, on rock, *R. D. Seppelt 7350*, 1.i.1980 (MEL 1029374).

DISCUSSION:

P. waiporiensis is the only species of brown *Parmelia* so far found on Macquarie Island. It was previously collected at Handspike Point by D. McVean in December 1968 (Esslinger 1977: 156).

PSEUDOCYPHELLARIA

Pseudocyphellaria delisea (Fée in Del.) Galloway and P. James, *Lichenologist* 12: 297 (1980).

Sticta delisea Fée in Del. *Hist. Lich.*, *Sticta*, 94(1822).

Thallus foliose, saxicolous or muscicolous, up to 30 cm diam., loosely to firmly attached to the substrate, pale brownish-yellow to olive to pale reddish-brown; *lobes* irregular, rotund at the apices, entire, crenulate, lacerate or deeply incised, contiguous or imbricate; *upper surface* smooth or reticulately ridged, shining, without soredia, sometimes lobulate sometimes isidiate; lobules dorsiventral, divided at the apices, concolourous with the thallus; isidia terete, slightly flattened, or inflated towards the apices; *lower surface* black, dull to slightly shining, densely covered with fasciculate rhizines, pseudocyphellate; pseudocyphellae white; margins of lobes usually smooth, bare, pale brown or buff, conspicuously pseudocyphellate; *medulla* white or pale brownish-buff. *Apothecia* up to 5 mm diam.; *margin* thin, crenulate or incised, strongly inrolled at first; *disk* cinnamon-brown becoming reddish-black, deeply concave; *hymenium* up to 120 μm tall; *asci* 78-90 $\times$ 15-19 μm; *ascospores* 24-27 $\times$ 8-10 μm, two-celled, hyaline, slightly pointed at each end. *Pycnidia* not seen.

REACTIONS: Thallus K−; medulla K+ pale greenish-yellow becoming yellowish-brown, C−, KC−, P+ red.

CHEMISTRY: Norstictic, stictic, peristictic, constictic and usnic acids, 7β acetoxyhopan-22-ol, hopan-15α, 22-diol and unknown triterpenes (Fig. 9).

REPRESENTATIVE SPECIMENS EXAMINED (total seen 35, Fig. 8):

Top of escarpment above Handspike Point, *R. Filson 6331 & P. Atkinson*, 11.iii.1964 (MEL 1024271); North-east corner of Lake Flynn, *R. Filson 5872 & J. Phillips*, 3.ii.1964 (MEL 1024260); Raised beach terrace north of Lusitania Bay, *N. Haysom 2134*, 23.iii.1950 (MEL 7704); Near the track north-west of Mount Gwynn, *R. Hnatiuk 11586*, 30.xii.1971 (MEL 1024295); Pyramid Peak, *R. D. Seppelt 10243*, 26.ii.1980 (MEL 1029362); Mouth of Flat Creek on side of rock stack about 20-40 m from north-east of beach, *K. Simpson E28*, 18.xi.1966 (MEL 1000278); Peak of hill on ridge above and north of Caroline cove, *K. Simpson E76a*, 20.i.1966 (MEL 26018); Along the escarpment between Mount Jeffreys and Mount Aurora, *D. A. Parker*, 18.x.1971 (MEL 1023774); Top of Gadgets Gully, *R. Waterhouse A99*, 11.iv.1972 (MEL 1020913).

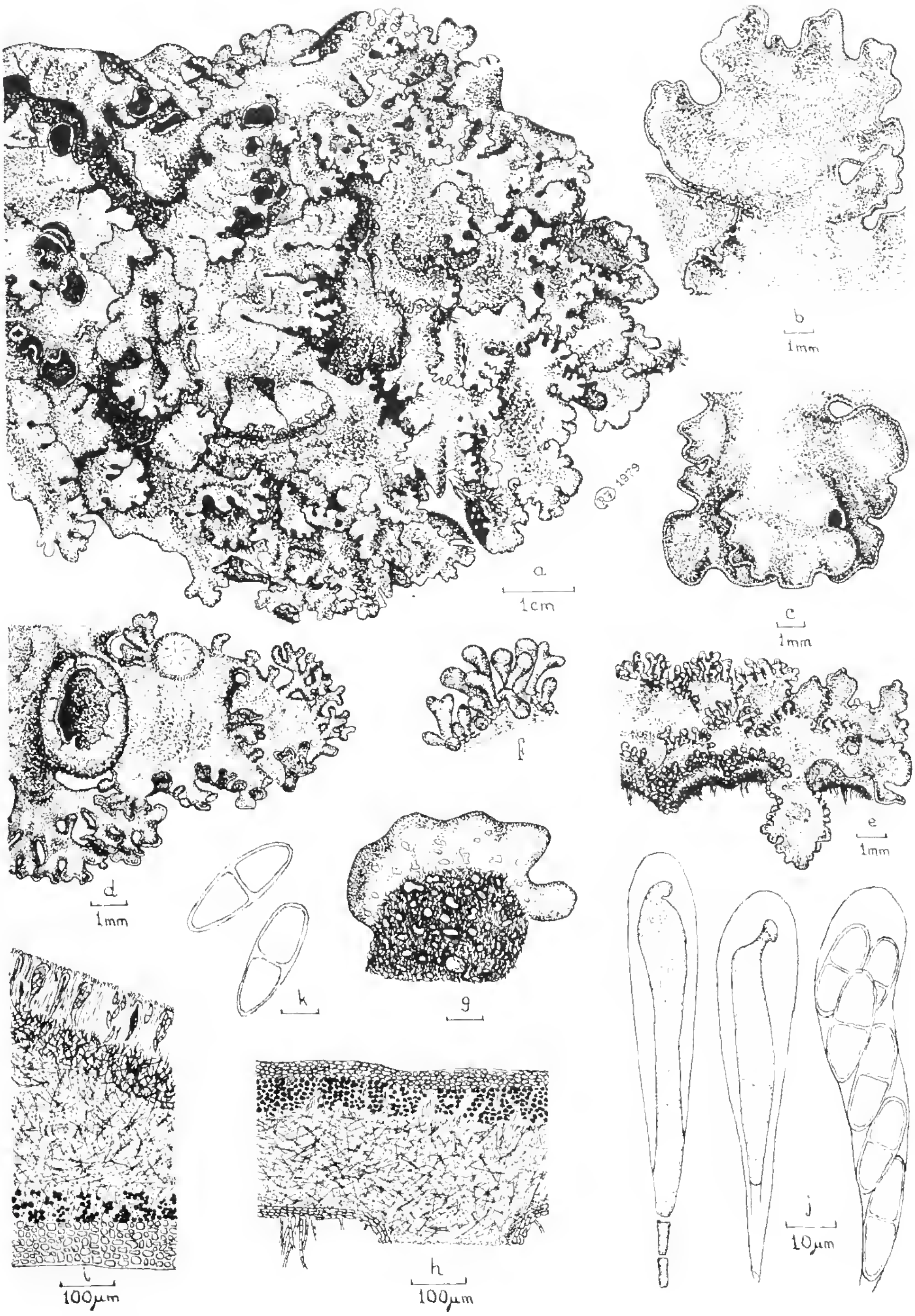

Fig. 10. *Pseudocyphellaria delisea*. a—habit (MEL 1024264). b—broad lobe (MEL 1024258). c—narrow imbricate lobe (MEL 1000435). d—lobe with apothecia and lobules (MEL 1024265). e—lobe with cylindrical isidia. f—enlargement of isidia (e-f, MEL 1024274). g—underside of lobe (MEL 1024262). h—section through the thallus; i—section through apothecium. j—three stages in development of ascus. k—ripe spores (h-k, MEL 1024263).

c

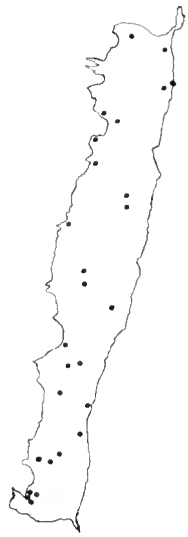

Fig. 8. Known distribution of *Pseudocyphellaria delisea* on Macquarie Island.

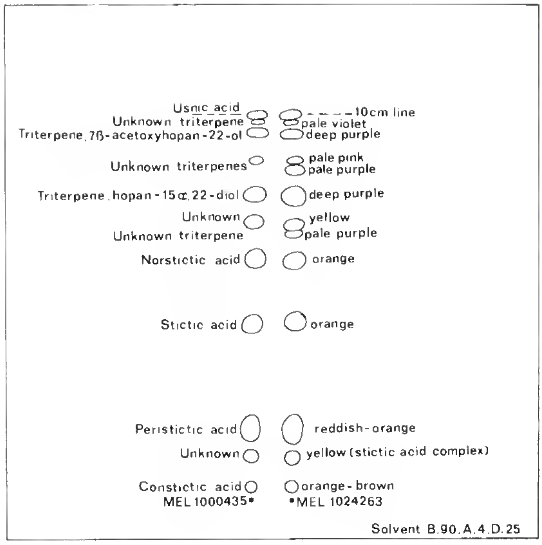

Fig. 9. Copy of Thin Layer Chromatograph showing products found in *Pseudocyphellaria delisea*. B, benzine; A, acetic acid; D, dioxane.

Discussion:

This species grows in a variety of habitats; most commonly it is found growing amongst grasses or over *Colobanthus* and *Azorella* cushions, but it often occurs amongst mosses and on bare rock. It is extremely variable and several distinct forms can be separated from the population including forms with broad, hardly imbricate, contiguous lobes (Fig. 10b), those with narrow deeply channelled or flat imbricate lobes (Fig. 10c) and forms intermediate between these two. Some forms are isidiate (Fig. 10e) or lobulate (Fig. 10d), some are isidiate and the isidia become branched and dorsiventral and resemble lobules (Fig. 10f), while on some the isidia and lobules are so sparse that they appear to be devoid of these features. The undersurface (Fig. 10g) at the centre part of the thallus is usually black but the colour varies towards the ends of the lobes; here it may become dark brown to almost black or any shade between this and pale buff.

The overall colour of the thallus is also variable. It is mostly a shade of brownish-yellow but in some situations the ends of the lobes become reddish-brown to dark brown. In exposed habitats the central parts of the thallus often blacken.

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VEGETATION OF THE GIPPSLAND LAKES CATCHMENT

by

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ABSTRACT

The catchment of the Gippsland Lakes, Victoria, was surveyed between November 1977 and December 1978, using a floristics-based, quadrat-sampling technique. The data from 722 quadrat sites were analysed via a computer-based, numerical sorting and classification procedure to determine the major, floristic vegetation types of the areas. These types were then arranged, hierarchically, into 13 floristic *communities* each of which contained one or more distinct, floristic *sub-communities*.

The communities defined in this paper range from alpine heathlands and woodlands in the north of the study area, through montane and lowland forests in central districts to coastal heathlands and woodlands in the south-east.

CONTENTS

INTRODUCTION

This paper presents the results of a vegetation survey of the Gippsland Lakes catchment. Its purpose is to define and describe the major floristic types in the vegetation of the study area and to give an indication of the geographic and environmental ranges of each.

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Muelleria 4(4): 333-383 (1981).

Fig. 1. Location of the study area. Stippling represents the Lakes Catchment.

THE STUDY AREA

The Gippsland lakes catchment is the combined catchment area of five major river systems which run into the coastal lakes of East Gippsland, Victoria (Figs. 1 and 2). These river systems are (from west to east) the Latrobe (major tributaries are the Thomson and Macalister Rivers), Avon, Mitchell (major tributaries are the Wonnangatta, Wongungarra and Dargo Rivers) Nicholson and Tambo (major tributary is the Timbarra River) Rivers. The catchment is approximately 22,000 km² in area and ranges in altitude from above 1500 m, in the Victorian Alps, to sea level. About 65% of the catchment is covered by native vegetation, most of which is crown land controlled by the Victorian Forests Commission, the Crown Lands Department or the National Parks Authority. The country devoid of native vegetation is predominantly privately owned and utilized for agriculture (mainly grazing) although extensive areas of crown land north and south of Sale support plantations of *Pinus radiata*. The largest area of unvegetated country lies immediately north and west of the lakes and extends to the foothills of the Great Dividing Range below 200 m (Fig. 2). This area is associated with the major townships and extends north and south of the Princes Highway between Warragul and Bairnsdale and east and west of the Omeo Highway between Bairnsdale and Omeo.

THE SURVEY

Method

FIELD WORK

The entire study area was divided into rectangles of dimensions 5 minutes latitude and 5 minutes longitude (Fig. 3). Within each rectangle substantially covered by native vegetation four sample sites were chosen (occasionally more in the varied vegetation near the coast and occasionally less in rectangles that were poorly vegetated) so that they differed as much as possible in gross habitat features (ridgetop, river, swamp, hillside etc.). At each site 20 mammal traps were laid (this survey was a combined zoological-botanical project) in an irregular line and floristic information was collected along this line and approximately 5 m to each side. The traplines varied in length but were commonly about 100 m long so that a vegetation sample usually covered an area of approximately 1,000 m². Within this area every vascular plant species was identified and assigned a cover-abundance value (Braun-Blanquet, 1928) corresponding to a visual estimate of its performance in the area.

In all, 722 sites (Fig. 4) were sampled from 179 rectangles between October 1977 and December 1978 (11 field trips each of 12 days duration). Approximately 25 rectangles eligible for sampling were not investigated, primarily because of their inaccessability at the time of survey.

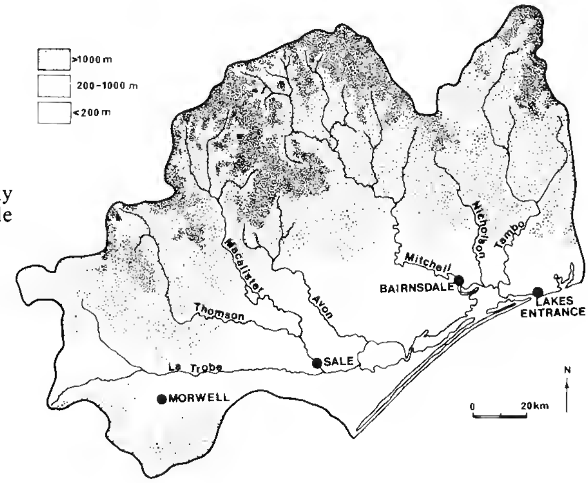

Fig. 2. The study area. Different density stippling represents different altitude ranges.

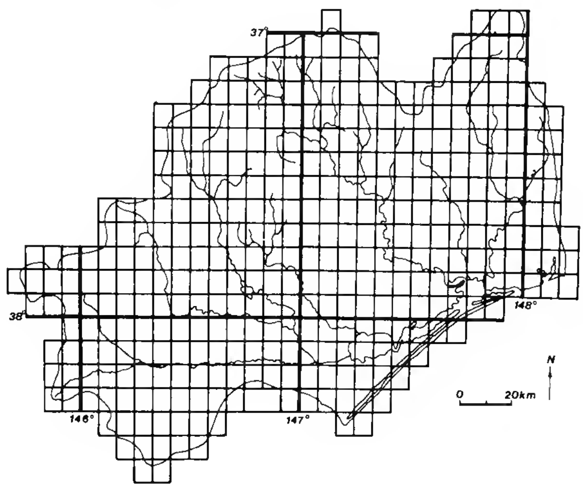

Fig. 3. The 5′ latitude × 5′ longitude grid system superimposed on a map of the study area.

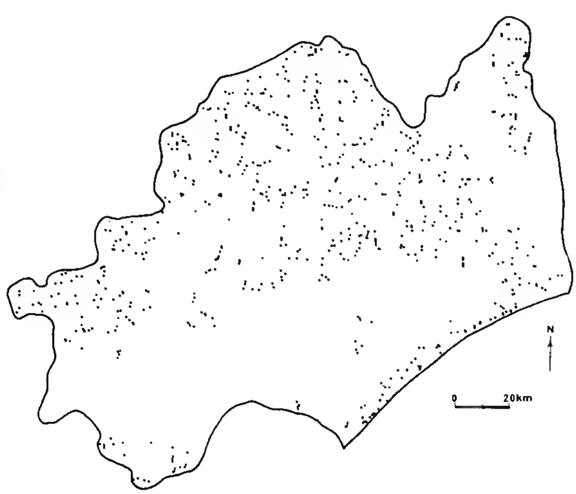

Fig. 4. Distribution of sample sites within the study area. The blank areas to the south-west and in the north-east are mostly agricultural land and *Pinus radiata* plantations.

Plant Identification

All plants which could not be identified in the field were collected, labelled and taken to the National Herbarium for closer examination and comparison with the Herbarium's reference collection. This allowed the identification, to species level, of all but a few plants collected. Nevertheless a number of qualifications must be made concerning the nomenclature used in this paper. As far as possible all nomenclature follows that of Willis (1970, 1973) with amendments by Todd (1979). However, due to the difficulty in distinguishing between certain closely related groups of species, particularly those for which vegetative parts only could be found, some names should be taken to mean one of two or more species. For example:

Eucalyptus rubida, *E. dalrympleana*—no distinction has been made between these closely related species. All have been recorded as *E. rubida*.

Geranium potentilloides, *G. solanderi*, *G. retrorsum*—distinctions between these species is difficult in the absence of flowering and fruting material. Wrong names may have been applied in these circumstances.

Hydrocotyle hirta, *H. laxiflora*, *H. algida*—as above.

Gnaphalium spicatum, Gamochaeta purpurea—as above

Poa australis spp. agg.—no attempt was made to distinguish between the 17 species of this group described by Vickery (1970).

Rubus fruticosis spp. agg.—no attempt was made to distinguish between the 8 species of this group described by Amor and Miles (1974).

Luzula campestris spp. agg.—no attempt was made to distinguish between the species of this group described by Nördenskiold (1969) and Edgar (1975).

Plantago varia—no attempt was made to distinguish between members of this group assigned to other species by Briggs, Carolin and Pulley (1973).

Juncus spp. (section Genuini)—species within this group may have been misidentified. The taxonomy of this section is in considerable confusion and current revisionary work is still incomplete.

Data Storage and Analysis

Floristic information from each site has been permanently stored on magnetic disk along with its locality (latitude-longitude), altitude (metres above sea level) and date of collection. Analyses were in the form of a computer-based, numerical classification procedure, coupled with a hand-sorting procedure of the type outlined in Gullan (1978). The final result of this type of analysis is a two-way table which contains all of the raw data in a sorted form. However, the two-way tables presented in this paper contain only a portion of the total number of species found in the survey. This is because most species occur in 10% or less of the sites and add little to the overall vegetation description.

The tables themselves are laid out in the following way. Numbers opposite 'QUADRATS' are labels for site localities. Each vertical column of figures represents a list of the species found in one site and each horizontal row represents all the sites in which one species has been found. The plus signs and numbers within the body of the tables indicate the cover abundance for each species at each site (See caption to Table 1).

The sample sites are not listed in numerical order, nor are the species names in alphabetical order, and this is so because the table has been sorted (by the above procedure) in two ways:

1. All sample sites which share a large number of species have been placed close together.
2. All species which are often found together in the field are placed together on the table.

Groups of sample sites have been defined and are delineated by vertical lines on the tables. These site-groups represent the vegetation communities and their sub-communities. Each of these will be examined in detail later in this paper. Horizontal lines on the table delineate groups of species which characterise each sub-community or community.

Terminology

The terms sub-community, community and character species have specific definitions in the context of this paper. The first two of these have been chosen to label vegetation types because they have not often been used in vegetation work before and consequently do not carry with them the confusion and controversy associated with terms such as formation, association and alliance.

Sub-community

A sub-community is a group of quadrats which have a similar floristic composition. It is synonymous with the term 'nodum' of Poore (1955) and is the basic unit of vegetation used in this paper.

Community

A community is a collection of sub-communities (or sometimes a single sub-community) which have floristic and environmental affinities. The community may represent a floristic continuum along which arbitrary divisions have been made to form sub-communities. It may also represent a collection of sub-communities which are considered to be different temporal phases of the same vegetation. Or it may represent a collection of sub-communities which are considered to be a single vegetation type under different disturbance regimes.

Character Species

A character species is one which occurs frequently and consistently within a sub-community and is consequently useful as part of the sub-community description. It is not necessarily confined to the particular sub-community. In this study, the minimum frequency of occurrence necessary for any species to be accepted as a character species has been determined in the following way:

Where F = minimum allowable frequency of a character species, and
Q = number of quadrats in the sub-community or community
Then if $Q <$ or $= 10$, $F = 55$
if $Q >$ or $= 50$, $F = 35$
if $Q > 10$ or < 50, $F = 55 - (Q - 10)/2$

Thus, if a community or sub-community contains 50 quadrats or more, a character species must occur in at least 35% of these. If a community or sub-community contains 10 quadrats or less then a character species must occur in at least 55% of these. Minimum frequency values for communities or sub-communities containing between 10 and 50 quadrats are calculated (by the above method) as lying somewhere between 55% and 35%.

The choice of the two frequency limits was arbitrary although based on the logic that as the number of sites representing a community or sub-community increases the necessary frequency of occurrence for useful indicator species decreases.

Community Names

Community names have been designed in this paper to take the form of "common names". These common names do not follow any set rules such as those of Specht (1970) or Braun-Blanquet (1928) because they are not intended to form the basis for a formal nomenclature. Their purpose is identical to that of common names used for animals and plants. That is, to provide a familiar and descriptive name which takes into account common, although often imprecise, terminology.

Each name usually comprises a structural part (heath, woodland, forest etc.), an environmental part (dry, wet, riparian, alpine, coastal etc.) and a floristic or life-form part (sclerophyllous, *Banksia*, Snow Gum etc.). However, some, such as Dry Sclerophyll and Wet Sclerophyll Forest, are "old-fashioned" names which have already become well-used common names, and others, such as Damp Sclerophyll Forest, are invented names which are designed to relate to the established terms.

The naming system devised here is not necessarily recommended as a standard to be followed by others. However, it is the experience of the authors that names of this type are those most frequently used in verbal discussions and descriptions of vegetation. They are offered here as a further means of conveying to the reader something about the vegetation being described.

Limitations and qualifications

Plant Identification

Each quadrat site was visited once only with the consequence that most plant species had to be identified without flowering or fruiting material. This problem was particularly acute during autumn and winter.

With experienced field botanists many species can be identified with confidence from vegetative material. However, there are always problems with monocotyledons and herbaceous dicotyledons (see previous remarks on Plant Identification). A more significant and basically insoluble problem is the absence of any visible signs of many annual species at certain times of the year (particularly autumn and winter). A few of these have been identified from dried remains present at the time of survey but many orchids, *Wahlenbergia* spp., lilies, sundews etc. will have been missed if the survey time did not coincide with the flowering period of the plant.

Distribution of Floristic Vegetation Types

The average distance between quadrats was between 4 and 5 kilometres. It is considered that this sampling intensity was great enough to determine all the major floristic vegetation types of the area and to give a good representation of their geographical ranges. However, the distribution maps provided in the RESULTS of this paper should not be interpreted as vegetation maps. They simply represent the distribution of each community or sub-community over all the sites sampled. If two adjacent quadrats share the same vegetation sub-community it *should not* be assumed that all the land between those sites also supports that sub-community.

Weed Problem

An index of introduced (since European settlement) plant species has been calculated for each quadrat site to give some indication of weed invasion into the native plant communities (see the sub-community summary sheets). It should not be assumed that this information is in any way indicative of weed problems or weed distribution in the study area as a whole. The purpose of this study is to examine the native plant areas and sites badly infested with weeds were purposely avoided. Therefore, while the list of native plants in this paper might be considered as a good representation of the native flora of the study area the list of weed species will be a gross underestimate. Similarly, many of the weeds that have been recorded in quadrats will be far more widely spread than this paper indicates.

RESULTS

For easy access of any piece of information relevant to the aims of this paper, the results of the survey and its analyses have been prepared in a number of ways.

Two-way Tables

The first of the data presentations is a series of two-way tables (Tables 1-7). These are the most important information sources for describing floristic variation

across the study area. They contain almost all of the raw data (only those species with occurrences in less than about 5% of the quadrat sites are absent) arranged in such a way as to represent:

a. The quadrats which make up each community and sub-community.
b. The species which characterise them.
c. The relationships and differences between communities and sub-communities.
d. The variation within communities and sub-communities.
e. The distribution of species not often characteristic of communities or sub-communities but which occur sporadically throughout the study area.
f. The cover-abundance of each species in each quadrat.

In short, the two-way tables contain the most complete and succinct description of the floristic composition of the vegetation.

It is worth noting that the two-way tables presented in this paper contain information from a much larger area and from sites much further apart than in most previous studies which use two-way tables (e.g. Bridgewater 1975, Gullan et al. 1976, Gullan 1978). As a consequence the tables are more heterogeneous than many others in the literature.

Community Descriptions

Thirteen communities have been described and named in the Gippsland Lakes catchment (GLC). These are representative of the major, extant vegetation types of the area. Other communities, now heavily disturbed or virtually absent, were obviously more important and widespread in the past. However, data from the present survey do not describe them adequately (due to the relatively low-intensity sampling) and no descriptions of them appear in this paper.

Of the 722 quadrats from this survey 48 have not been dealt with in this paper because they did not fit in to the vegetation classification. These quadrats contain vegetation which is grossly disturbed, representative of communities which are no longer widespread (e.g. Open-Forests containing *Eucalyptus tereticornis*) or fragments of vegetation types better developed elsewhere (e.g. western remnants of East Gippsland rainforests).

The following is a brief description of each of the major communities:

GLC COMMUNITY 1: ALPINE WET HEATHLANDS (2 sub-communities; 32 sites). Closed heath to low woodlands of plains and damp depressions in the high country from the Nunniong Plateau to the Snowy Range.

GLC COMMUNITY 2: SNOW GUM WOODLANDS (2 sub-communities; 33 sites). Low woodland of the well-drained ridges of the high country from the Nunniong Plateau to the Snowy Range but concentrated in the Mt. Hotham Area.

GLC COMMUNITY 3: MONTANE FOREST (3 sub-communities; 117 sites). High altitude open and tall open-forest. The predominant vegetation of the high country from the Nunniong Plateau through to the Baw Baw Plateau. It is found primarily on the more sheltered hillsides away from exposed ridges.

GLC COMMUNITY 4: MONTANE RIPARIAN FOREST (2 sub-communities; 41 sites). High-altitude, riparian, tall open-forest occurring in the upper reaches of rivers from the Tambo to the Macalister. It is closely associated, both floristically and geographically, with the Wet Sclerophyll Forest of community 5.

GLC COMMUNITY 5: WET SCLEROPHYLL FOREST (1 sub-community; 73 sites). Tall open-forest usually dominated by *Eucalyptus regnans*, but otherwise dominated by a mixture of *E. obliqua*, *E. cypellocarpa*, *E. viminalis*, *E. radiata* or *E. dives*. This forest occupies two distinct parts of the study area. The

largest and best developed forests (mostly *E. regnans* forests) are west and south of the Snowy Range. The other area (where *E. regnans* is uncommon), south of Omeo, is less extensive and confined to the upper reaches of the Nicholson and Tambo Rivers.

GLC COMMUNITY 6: DAMP SCLEROPHYLL FOREST (6 sub-communities; 118 sites).
Open-forest community distributed throughout the intermediate altitudes of the study area in a broad band from Powelltown to Buchan. This community is floristically quite variable both compositionally and diversally. This is indicative of its wide geographical range and heavy forestry usage, accompanied by intense and varied fuel reduction procedures.

GLC COMMUNITY 7: MONTANE, SCLEROPHYLLOUS WOODLAND (1 sub-community; 28 sites).
A woodland community distributed on exposed ridges to the north-east and south-west of the Snowy Range. The understory is dominated by sclerophyllous, small-leafed, heathland-type plants.

GLC COMMUNITY 8: DRY SCLEROPHYLL FOREST (2 sub-communities; 76 sites).
Open-forest scattered on dry foothills surrounding tributaries of the Tambo, Nicholson, Mitchell, Avon, Macalister and Latrobe Rivers.

GLC COMMUNITY 9: RIPARIAN FOREST (4 sub-communities; 57 sites).
A floristically rich, riparian, open-forest scattered through dry foothill country surrounding tributaries of the Avon, Mitchell, Nicholson and Tambo Rivers.

GLC COMMUNITY 10: *Leptospermum myrsinoides* HEATHLAND (1 sub-community; 25 sites).
Low open-woodland and closed heath inland from the Gippsland lakes and the Coastal Banksia Woodlands. This community is distributed mainly south and west from Sperm Whale Head on podzols developed from siliceous sands.

GLC COMMUNITY 11: LOWLAND, SCLEROPHYLLOUS FOREST (2 sub-communities; 28 sites).
Open forest distributed in the lowlands north of Lakes Entrance.

GLC COMMUNITY 12: COASTAL BANKSIA WOODLAND (1 sub-community; 43 sites).
Low open-woodland distributed along the leeward side of the Ninety Mile Beach, all around the Gippsland Lakes, immediately adjacent to the water. The soil supporting this community is made up largely of calcareous sands.

GLC COMMUNITY 13: PRIMARY DUNE SCRUB (1 sub-community; 3 sites).
Primary dune community of low shrubs, forbs and grasses extending from Seaspray to Lakes Entrance.

Sub-community Summary Sheets

The following three sets of information have been incorporated into a single-page layout for each sub-community. This combination of information constitutes the primary means of describing vegetation in this paper.

SUB-COMMUNITY DISTRIBUTION MAPS: For each sub-community, the distribution of all its constitutent sites (large black dots) has been superimposed on a map containing the Lakes, major river systems and basic topographic information.

SUB-COMMUNITY TABLES: In these tables information from the two-way tables has been summarised and presented in a simplified format. The names of the species which are characteristic of a sub-community are listed along with their frequency of occurrence and the average cover-abundance (C/A) of each species when it occurs. The order of the species in these tables is in accordance with their frequency in the sub-community. This order is at variance with the two-way tables which arrange

species so that sub-community and community interrelationships are best demonstrated. Consequently, although it is easier to assess individual sub-communities from the sub-community tables it is less easy to compare one sub-community with another.

SUB-COMMUNITY DESCRIPTIONS AND ANNOTATIONS: A simple verbal description has been made for each of the sub-communities which includes briefly summarised information on their distribution, environment and conservation significance. Included with these descriptions are details of altitude, vegetation structure, floristic richness and weed composition.

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Table 1. Two-way table of Communities 1 and 2.

Cover-abundance symbols:
+ <5% cover, uncommon
1 Up to 5% cover, common
2 5-20% cover
3 10-50% cover
4 50-75% cover
5 75-100% cover

COMMUNITY	1		2	
SUB-COMMUNITY	1	2	1	2
QUADRATS	00000000	00000000000000000000000	0000000000000000000000000	00000000
	11333311	33223333322333323333333	2233222222222222222211134	22221111
	00000000	00000000000000000000000	0000000000000000000000000	00000000
	00614225	01663211167142344561503	4400000111124144222217722	44643222
SPECIES	81584741	49565126776309436901597	1612389012512645345830881	78898053
Comesperma retusum	1+1++	+ +		
Oreobolus distichus	1++ 1	+ 1 +		
Baumea gunnii	11+1	++ +		
Sphagnum spp.	2 2 2 5+	3		
Restio australis	2 2 2+	2 11 1 2+		
Epacris breviflora	+++221	41 1112+ + +		
Hakea microcarpa	211221	122 2 1111 + 1	21	12 1
Epacris microphylla	31 21 +	2 22 1 12 21 +3 2	1 1	
Gonocarpus micranthus	1 1111	+ 11 + + + + + 1 +1	+1 +	+
Epacris paludosa	2+232322	2222212113+23 3 12+	+	
Baeckea gunniana	23133322	3122321 1 13311 1 2 21	2	1
Empodisma minus	33334332	21+13+12 1+332 +3+2		
Callistemon sieberi	2 1 23 2	222 12 1 12212+3+1 2	1 2	
Bossiaea foliosa	+ +	312+1 1 22+2 22 2	1 1 1 2	1 11
Eucalyptus stellulata	+1+ 1	13221 1222 1 3	12	+ 21
Oxylobium ellipticum	+	2 2111 1 3112 1	2	
Gnaphalium japonicum		111++ ++ +1	1 +	+
Leptospermum grandifolium	1	2 2 22 2 +++ 4	+	23
Deyeuxia quadriseta	+	1 1 + + 1+ ++ 1+++1 1	+1 1 1 1 + 1+	+ +
Carex breviculmis	+	++ ++ + 1+ ++1+ 1	+ 1 1 1 + + 11	+1
Leptorhynchos squamatus	11	1++ + +++1+ ++ 1	1 + 1 1 1 1 1 1	
Blechnum pennamarina	1 1	+ +111112++ 11 2	+ 1 +	2121
Carex appressa	1 1 2	2231222121 11 +4	1 2 1 1 2 2 1	5221
Gonocarpus tetragynus		++ ++1+++ + +11+++ ++	+ 1+ 1 ++1 1	+ +++

Comesperma retusum
Oreobolus distichus
Baumea gunnii
Sphagnum spp.
Restio australis
Epacris breviflora
Hakea microcarpa
Epacris microphylla
Gonocarpus micranthus
Epacris paludosa
Baeckea gunniana
Empodisma minus
Callistemon sieberi
Bossiaea foliosa
Eucalyptus stellulata
Oxylobium ellipticum
Gnaphalium japonicum
Leptospermum grandifolium
Deyeuxia quadriseta
Carex breviculmis
Leptorhynchos squamatus
Blechnum pennamarina
Carex appressa
Gonocarpus tetragynus

Brachycome aculeata	+	++ +11 +111 + 1	+1+++ 1 1 1++ 111 1		Brachycome aculeata
Helichrysum scorpioides	+ +	+ 111++ 111+ 1 1+1	+ +112 +1 11 + + +	+	Helichrysum scorpioides
Stylidium graminifolium	11++	1++ 111++1 12 1111+ 1	1 + ++1 + 1 1+ 111	+	Stylidium graminifolium
Grevillea australis	22	1111+1111 1 21+ +2 +	1 + 2 2 1221 2 2		Grevillea australis
Tasmannia xerophila		+ + 21 112321++ +2	11+122 1 21+111+1+++122	1	Tasmannia xerophila
Asperula gunnii	1 1++1	+1 + 11 ++1+ 11+1 1	1 +1++ 111++ 1 + 111+		Asperula gunnii
Celmisia longifolia	1 1++	+1++ ++ ++11 +1111++1	++ 1+ 1 1 +111 11+ 1212	+ +	Celmisia longifolia
*Trifolium repens	++++	1 111 1++1+1 + + + +	11 + + +2 +11 1	111+	*Trifolium repens
*Acetosella vulgaris	+	+ + + +21+ 1 ++1 +	1+ 1+1+112+12 2111+ ++ +	++ ++	*Acetosella vulgaris
Viola betonicifolia	++	1+ 1 ++1+++ ++ + +	1+11+++11+1++++1+11	111	Viola betonicifolia
Oxylobium alpestre	+	2 1+ ++ 111+211+ +	131433 434322122241+ 32	1 14	Oxylobium alpestre
Eucalyptus pauciflora	+11	2 +112112+311 23122 24	233232+33+2 311222332 33	233 113	Eucalyptus pauciflora
Leucopogon suaveolens	+ +	1 +11 + 1+++1 1+1+ 1	+1++ 1 +2 2 1+11+211+1+1+	121 11	Leucopogon suaveolens
Stellaria pungens	+	++ +111111++++1 +1 1	11+1 111111+111+1111+1 11	111+++++	Stellaria pungens
Oreomyrrhis eriopoda		1 + 11+1+1 1+ 1 11	11+1 111+1 11+11+ 11 111	+11+ +++	Oreomyrrhis eriopoda
Cotula filicula	++1 +	1+ 11++ + 11++++++++++	+11+++++ + 11 +++ 1 1	+++1+ +	Cotula filicula
*Hypochoeris radicata	+	++1++ ++++1++111+11 1	+1 1 111+1111111++2 +	+++ +1+	*Hypochoeris radicata
Luzula campestris spp. agg.	+ +	1 + +1 ++ +++ +++ +++	++++ 1 1 +1+ 1+ +++1 1	++1++1++	Luzula campestris spp. agg.
Acaena anserinifolia	+ + +	++11+1111111++11+ +11+	11 11111+2 11 1 11 1+1+ +	1111111+	Acaena anserinifolia
Poa australis spp. agg.	+1 122	2232+11121+21+11212221 1	33221221321111221+21232322	23 122 4	Poa australis spp. agg.
Epilobium cinereum	+	11 +1 + 1 1	1+ 2+12+1 11 + + + +	11+1	Epilobium cinereum
Polystichum proliferum		++ 1+ + ++ ++	+++12 11 1 1++ +1 1 + +	1++1 +	Polystichum proliferum
Geranium potentilloides		11 +1+1 +	+1 11+11+1 111++1 1+1+ 1	11 111+	Geranium potentilloides
Veronica derwentia		++111+ 1	++111 1+ 1 + +	1 +1	Veronica derwentia
Prunella vulgaris		1 ++ +1 + +	++ ++ 1 ++ 1 +	+++	Prunella vulgaris
Viola hederacea		+ 1+ ++++ 1111+++	1 ++ + ++1	+	Viola hederacea
Arthropodium milleflorum	+	+ + +	+ + +++1+ ++1 1 + ++	+++	Arthropodium milleflorum
Scleranthus biflorus		+ 1+ ++ 1	++ + 11 11+ 11 ++ +	+1+ +	Scleranthus biflorus
Senecio lautus		+ + 1 1	1111 +1 + 1+ 1 ++ 1	111	Senecio lautus
*Cerastium glomeratum	++	+ + + ++ +++ +	1 + + 1 +1 +1+ +++	+++	*Cerastium glomeratum
Craspedia glauca	+ 1+	+ + 1 +1 + +	+ +11111 11+ 1 + 1	+	Craspedia glauca
Danthonia nudiflora		1 + + 1	++1+ ++ + +++ + +	++	Danthonia nudiflora
Agropyron scabrum		+++ ++1+	+ 1 + 1 1 ++ + +	+1+	Agropyron scabrum
Dianella tasmanica	+	+ + + +	2 +11+ 1 1+ 1+ +222		Dianella tasmanica
Olearia phlogopappa		1 1 + 1 21 + +	1+ 1 + 1 112+2 2+ 32	+ ++	Olearia phlogopappa
Olearia erubescens		+1 + + 1+ + ++	++++ 1 + + +11+	11+ 11	Olearia erubescens
Hydrocotyle hirta		111111 1+1 +11	1 1 1+ +	111+	Hydrocotyle hirta
Rubus parvifolius		+ 1 +	+ 2 11 2 1+ +	11 211	Rubus parvifolius
Daviesia ulicifolia	1	+ + + 1	++ 1 11 1+	+ 111	Daviesia ulicifolia
Asperula scoparia		++ + + 111	+ + + 1 +++	+11 1+++	Asperula scoparia
Eucalyptus rubida	+	1 + 2 1+1+ + 31	1	1 111	Eucalyptus rubida
Ranunculus graniticola	+	1	+1 1++ 1	+1+++	Ranunculus graniticola
Lomandra longifolia		1 + 1 112 2	+ +	+ +	Lomandra longifolia
Lagenifera stipitata	+ +	+++ + 1 ++	+ 1 1+ 11 ++	1+ +	Lagenifera stipitata
Olearia megalophylla		+ 1 +	+1 1+ ++	+	Olearia megalophylla
Ranunculus plebeius	1	1 1+ 1 +	+ +	+	Ranunculus plebeius
Pimelea linifolia	+	1 + + 11+ +11 1	+ +		Pimelea linifolia
Wahlenbergia gloriosa	+	1 + + +	+ 1 1 1 ++ +		Wahlenbergia gloriosa
Oxalis corniculata		++ 1+++	1+ ++ + +		Oxalis corniculata
Acacia obliquinervia		+	+ +1 1 +	+	Acacia obliquinervia
Polyscias sambucifolius		+ +	2 21 1 1		Polyscias sambucifolius
Coprosma hirtella	1	+ +	+ + 1+ 1 1+		Coprosma hirtella
Acacia dealbata		+ + ++	+2	+2	Acacia dealbata

Table 2. Two-way table of Community 3.

COMMUNITY	3		
SUB-COMMUNITY	1	2	3
QUADRATS / SPECIES	000 111 000 300 732	00000000000000000000000000000000010000000000000000000000000000000000000000000000000 33222222222222222212211111111111414222211111144222222222444422111111111111222222224 00000000000000000100000000000000000000000000000000000000000000111000010000000000000 53235573331552221663113015124223252566435035343013455770022551117678174081167772 62800231239417064126044926123161229934910752007574078986725358751926698603801276	00000000000000000 00000100000000000 22231333399999333 3333313999933333 00000000000000000 00000000000000000 15761166512445446 13435250024334441 46435046132493582 46737185813891235
Epacris impressa	++	+ 1 2	2
Danthonia spp.	1+		
Deyeuxia spp.	1+	+	
Epilobium spp	1+	+ + ++ +++ +	
Brachycome decipiens	1 +	+ 1 + +	1
Carex breviculmis	++	++ + + +	+1 + + + + ++
Dianella revoluta	++	+ + 11 + 4 1	
Eucalyptus radiata	12	+ + + 2 1 1 1 2 1 2 1 1 22 1	2 3 1
Exocarpos strictus	1 +	2++ 1 1 + 2+ + 1 11 +	
Persoonia chamaepeuce	1 +	+ 1+1+ +2 1 111 1 1 +	1 1 1
Acrotriche serrulata	1+1	1 + 11 1 1 + +	
Hibbertia obtusifolia	+1+	+ + + 1 + 1 1 +	
Pultenaea juniperina	442	1 311 2 1 1+31 + + 1 1 2+1	2
Craspedia glauca	+++	+++ + 1 1 + + + + + + + + ++1+ + +	+++ + + 1
Ranunculus graniticola	11+	+ 1++ + 1+ +++ ++ + + 11 1 +1 +1++ ++	+
Platylobium formosum	122	11 2 32111 12+ 2 1 112322 +2 22 1 11111 1 11+ + + 1 1+	+ 2 +
Eucalyptus dives	12+	11 311 2 1 1+1 11 22 2 12222313111 12 12222 12221 2122122 3	1
Eucalyptus rubida	121	22 2121112212 +1 211+1 12121111 2211211 1 1121 1122 11 221212222 1 1 1122 12+	1 +122 1 1 222 +2111 +1
Lomandra longifolia	+1	1 + 1111+++ 1+ + +1+1111+111111 + ++ +11111 112+ +1+1 ++1 1 1 +11++++1	+ 1 1 11+1+ 1 1
Asperula scoparia	1+	1 +111+ + + 1121+ ++++1111 1 11 11 +1 + 2 111+ +1+ 1+ ++	+ 1121 ++ +1 +1+++
Eucalyptus pauciflora	1 1	2 32223232122321 22+134311221212212322 2132+3	2 1212 34 32+ 3 23+
Hydrocotyle hirta	++	111 + 1+++ 1111+ 1 + 11+ 11 ++++1111 22 111+111+1+ +111+1	1 +++ 1 1+1 +1121 ++ 111+
Gonocarpus tetragynus	+1+	++1111+111112+1111+ + ++ +1 ++ 111++++ +1++11111 1+ 111+11111+ + 11 1 1211+1	111 ++1+ 1++++ 1 1+++ 1 + ++++
Helichrysum scorpioides	+++	1 1 1 1++1 1 11+ +++ ++ 1 11 + 11 1+11+ 1+1 + 1+1 1 1+	1 1+1+112 1+1+1 1+111 1 +1111+
*Hypochoeris radicata	1+	+ + + + 1 + + 1 +++ +++ ++ + +1++ ++ ++ + + ++	1 +++++1 2 ++ + ++ +2+ ++ 1+
Cassinia aculeata	11	11+1 1 + + ++ 1 111 +1+2+ + + +1+11+++12 121 11 1+11++11+ + 1	++ +1 21+ 2 11 1 113+111 1 1
Geranium potentilloides	++	1 1 +2 1 + 11+++ ++++ 1 +++ 1+ + + + 1++ +11+ 1+ ++++1++++	+1 11++ + + 1 111+1+ +1+
Olearia erubescens	+1+	1 1+ 111111 +1 1 +1 +1 +1 1 ++ + +1 11 ++ 1+1 + + + 1+111+	1 1+ + ++ 11+11 ++ 1 + 1 11
Luzula campestris spp. agg.	11+	+++ 11 + 1 + ++++ 11+1++1 + ++ ++ ++ ++ ++ ++1+++++ ++ +	1+++ + 1 ++ ++ ++ +11 ++ ++++
Acaena anserinifolia	+1+	1 1112+ 1 1 + 121+++++1+1111 ++ 11+++ 11 11 +1+111+11211111112+1++211	111 +1211 +++1 + 1+++1111+11+111
Poa australis spp. agg.	322	2123322223232122144324222332231222122 +213121122+121 1 2232121221211122 122111	1222++2313121122222212+1 41111221
Stellaria pungens		11111211+11++2 111+1 +11+++++ 1+11 + 1+ 111+ 11111111+111 ++1 +111111	111+ 1111 1111+ +111+ 1 1 111+++
Dianella tasmanica		2+1+1 1+111+11 1 11+1 ++++1+ 1212 131221 +1++1221211+1111 22212111 2122111+	211 + 2121111111+21+12121++1111111
Stylidium graminifolium	+	+1+11+1111+12+1++ + ++2 1 1 111+1++ 2 +111+111111 111111+++1 1 + +1+111 1	11 ++11 2111111+11 1 1++ + 111 +
Oreomyrrhis eriopoda	+	1 11 + + 1 ++ + + + ++ 1 + 1+11111 1 +++ 1++2	+11+ + 111 1++1++ 11+ 21 11 1+1
Cotula filicula		+ 1 +1+ 1 + ++ +++ + + ++++ + 1 ++1111 +1 +1+ 1 +++ ++1+1	111 +1 12+ 1 111+1++1+ 11 11 111
Acacia obliquinervia		1 + +1211211111 +11+ 1 1 21 +1 2 2 2 221 1 1 + 2 1 1+1+11 1	1221 111 2 1 11121 111 +1 211
Viola hederacea		++ 1 + 1 1++ ++++1 1+ 11+1++11+111 1 111++1+ 11 2211111111++ 11111	+ 12+++++1+1 1++1++ 11111+
Polyscias sambucifolius		+ 2 + 211+ +1+ 1 1 1 1 1121 11213+ +2+ +11 +1+ 1 21 +12+ +121++1+ 1+	1++1 +121 +++1 1+111111+2111 2 1
Eucalyptus delegatensis		22 33 1 2 2 1 3 2 2 22 33 + 1 13 32 ++13 122 1	3332+ 4 +12+33231 222 12
Daviesia ulicifolia		111 1221112111 21 1 12 1 2+ 22 +21 2 11 +1 +++2+ 2 1+1 1 1	12+21 1 2 11+ 1+ 1 1 1 +

D

Leucopogon suaveolens	+	1 12+ 1+ +122121 + +1 1 11+12 1 + + +1 2112121+ 111 + + 2	111 11 1 111 +1+
Coprosma hirtella		+111 1+11++++2 + 1+1 ++1 1 +11 12122 +1 +111 111 11+2++ 11111+1++111 +11+	1 21++1+ 11 211+1 1111111++ 111 1
Acacia dealbata		11 1+121211+2 1112+ +2+321 2 +2+122 1+23 ++++21 22231+231122111113211111122+	11 ++ 1 1 1 1+1+222+ +1 1 2
Polystichum proliferum		+ 1+ 1+ + +++ 1+ ++ 1 ++1+ + 1 1 23112 2311++11+1122+111212	+++1 ++11+ + 2 1 1121+1111+122
Lagenifera stipitata		+ + 1 + 1 1 + + + ++ ++++++ +11++11++2 +1111 ++11+ 1++1++1	1+1 11 ++ 1 1++ 1+1 + 111+11
Senecio linearifolius		1 1 1+++1+1 2+++ + 11+ 1++ 11	2+ 1 1 ++ + 1 2 11 ++1 11
Olearia phlogopappa		+ + + + ++ + ++1 ++ 11 1 ++ 1+ 11++1111 + 12	1 11 12211 1 1 11+111+12+1++11
Veronica derwentia		+1 + +1++ + + 1+ 2 1 + 11++1+ 11 1	21 +21 + + 11 11+1+ 2111++
Oxylobium alpestre		1 1 213 1 111 1 21 22 + 3 4 2	222 +12 3 23 2 + 33
Brachycome aculeata		++11+ + 111+1+ + + +++1 + + 1 1	+111+1+1 111+ + 111+
Viola betonicifolia	+	111++ + + 1 +1 + + ++1 1 11 2++ ++ 1	11+ 1+ +++ + +
Arthropodium milleflorum		1 +1+++ ++ 1 1 ++ ++ 1 + + 1 +++ 1 111+ +++ +	111+ ++1+1 1+1+ +1 + +1+
Tasmannia xerophila		+ ++ + 1 3 1 11+31 + + 1 1+ 1 1 +2 +	+ 1 12+ 1 +2 1 +21
Ranunculus plebeius		+ + 1 + + 1 1 + 1 +1 +	1+ +++++ 1+ +11+ 11++1+
Leucopogon gelidus		1 +21 1+ 1 111 1 + 1 1 1 1	2 + ++1 ++ 2 1 + 1+1+1 1
Olearia megalophylla		+ 1+ + + + 1 +	1 1 1 1 2 1+ 1+1 11+ 11+1 1
Deyeuxia rodwayi		+ 1 + 1 11 ++ +1+ +	2 1+ 1 1111 11 1 ++1
Epilobium cinereum		1 + 12 + + ++ + + + ++	11 + 1 + 11 ++++1
Asperula gunnii		1 + + +++1 2 1 + 1	2 1+ + + 1 1 2+
Daviesia latifolia	+ 2	3 1 1 1 1+ 55 + 2	2 + 2 13 33 2
Gnaphalium japonicum		11 + + + + + 1 ++	+ 1 + + 1++ + ++
Leptospermum grandifolium		2	+ 11 + 222+331 12
Carex appressa		2 2 + 1	1+ +422211121
Pteridium esculentum		1 1 + 1 2 21+ 1 2 1 1 1+ 2+13 2112111+21 +21111+11221112112211	1 1 1+11+ + +
Clematis aristata		+ +1 ++ +1 ++++ ++ + +++++ ++ + + 11 + ++++1 +++++11 11+	1 1 11 1 1 +
Poranthera microphylla	+	++ +++ + +++ + ++++ + + + +++++ + ++ + +	+ + 1 + + +
Senecio quadridentatus	+	1++1 + + + + + +1 + +++ + + + + ++ ++1 +1111 1 + + 1	1+ 11 + 1+ 1 1 ++ +
Olearia myrsinoides		+ ++ 1+ 1 2 1 + 1+1+ + + ++ 1++ 1 + 111+ +1	+ +
Celmisia longifolia		++ + 112212 1 + 11 1 + 11+ ++ 1 ++++	121 1 1+ 11
Stellaria flaccida		+ 111+ +1 1+ + 2 1 111 1++	11
Lomatia myricoides		+ 1 11 1 1+11 + 1 11	

Table 3. Two-way table of Communities 4 and 5.

COMMUNITY	4		5
SUB—COMMUNITY	1	2	1
QUADRATS	000000000000 333333211133 000000000000 024666733825 369789532550	00000000000000000000000000000 44444444444442444444422211421 00000000000000000000000000000 45544150123330511111200054504 57329543803782902419446730512	000000000 000000001111111111111100100011111111111000000000 00000000000000 444441111 111111110000000000000000110144000000000000999999999 99999999999999 000000100 101011010000000000000000011000000000000000000000000 00000000000000 455000067 170801805433313444544444401262221005400003155544322 2221000005466 168545867 269313021183229293287654618798608700324175971218754 3079743218887
SPECIES			
Eucalyptus delegatensis	++1+22121	3 1 1	2 + 2 1
Hypolepis rugosula	++ 1++ +	+ + + 1	1 + 1
Blechnum fluviatile	1111+11+1		1 + 2 + 1 + 1
Tasmannia lanceolata	2 2+1 1+1	1 +1+ +	+2 1 +2 1+2 +1 + 2 + 1 +
Daviesia latifolia	1221+ +	1 +1+ 1 1 +	+ + 1 + 1 +
Veronica derwentia	+1111	++1 11++ 1 +1 +	1 + 1 + +
Epilobium billardierianum	1 1 11 +1	1 + 11 1 ++ + +	+ +
Stellaria pungens	21+ 1 +	++ 1++++11+ 1 1+1 ++ +1++++	+ +1 +
Leptospermum grandifolium	+312 13 2 2	+ ++142 1+1 11+ 2 41	1 21 2
Rubus parvifolius	12+22 + 1+2	1111+ 11++11+212111+12121 +12	1 2 + 1 + + 1+ 1 1 + 1 1
Eucalyptus viminalis	12 11 13	22 21 1 113 2222 31212 11	231 2+ 1 1 1 11 2 2 1 3 3
Gnaphalium japonicum	1++1++ ++	++1 + 21+1 ++++ +++++1+ +	1+ + + 1+++ + +++ + + + 11 + + 1
Lagenifera stipitata	+1++ ++ +	+ +1++2++ + 111 11+ 1+	1 11 + + + +1 1
Cotula filicula	+11 1+ + +	++1 ++ + ++11111 ++ + 1 +	++++ 1 1 1+1 +1 + 1 ++ 1+ +1 1 + + ++
Carex appressa	1212 11 111	1+3 1 2313112311+ 211 2 1+241	1 1 1 11 + 1+ + 3+ + + 1 11 1 11 11 +1 ++
Poa australis spp. agg.	++223111 211	1 2 12111 1111111++ 111+ 22	121 1 2 +++ + 1 1 4 + ++ 1 1 11 ++ 2 1
Viola hederacea	1+1+ + +	+111 1111 11++11+1+1+1+1 11 1	++11 11 21111111111+ +1 1 1+111111+11 11 1+1 +12 111+++ + +1+1111 +1+
Acaena anserinifolia	+111211+ 112	+ 21 1+1+2111 11111121 1111	2 1 1 1 11 +111+11+11+1++111++2+111++1 11+++11+ + 1++11++11 + + +11+
Acacia dealbata	2 11121+ 12	+222111+1+++1222+ 112121+++	22 121112 22112111111 1 1 1112 221 211242111 +11223221132 +122 1 11+111
Hydrocotyle hirta	1111 + 111	+11 1211111+11111 1 11+ 1	2 +++11+ 1+1+1+ 1111+11+111121+11+ + 11+++11+ ++ 11+11+ 1+ +++++1+ + +
Cassinia aculeata	+ 1221++ 12	221 1211 222112+2112 +1+2	11211 + 12 11111111+ 121 11+21 ++12111 1 ++121 12+111 1 1 11212++++
*Hypochoeris radicata	+++1+ 1 +	11 +1 1112++ + +2 11 + 2	++1 1 11 + +1+2111++ 1 ++ + ++ ++ + +1 +2 +++ ++ +
Geranium potentilloides	+11111+ 111	1111++11+1111 1111++1111+ 1+	++ 1 111 12111+11111 1111112+ 11+1+1+++11+1 ++ 11 1 1 11 +11++ +
Polystichum proliferum	211132233+ 1	+1 13+ ++ 11212 2+1112++	+ 1334211 222 11+1211 1+1 121122+312212 131221++ +112331131 122121++ + 3
Stellaria flaccida	2 21 1+1 1	+ + +++ ++1 1111 1 +	+1 1 +112 1112 +1+1 2 111 1 1 2 1 + 11+2121 1 2 1 21 1 + 1
Polyscias sambucifolius	11+++ 1++ +1	11 +11+ +1 1212+ +++ +	11++ 1 1 1 + + 1 +1 +++++1+2 1 11 222 1+11 1 +1++ +
Blechnum nudum	2 + ++ +1	112 2 1+1123111 2 123 5111	41 2 13+21 2 + +11221+1++1 2 ++ 1 2 2 +1
Urtica incisa	11 1221 1 1	+ 1 ++ ++ + +++	+ 13 1 2 +111+ + 1 21 11+1 2 11 + 11+ + ++
Clematis aristata	+ 1 + ++	+111 +1++ 111++111 +1111++ +	11111 + + 1++ +1+11+ 11+1+ 1111+11 1+111+1 11+ 1111+1 1+1 111211+1++211+
Pteridium esculentum	1+	1113+1211+1 +1 +1212221111 +1	++211 111 +1+1231 11121+++1 1++++ 211111++11+++1 1+ +1+ 1 ++1111 + +
Coprosma quadrifida	1 +2	11 ++1 21+12122222113211 1 1+	12 1 1+11+1+11 + 12111+1111+12 12+1211111 11 + 1 1 + 111+ 1 1113
Pomaderris aspera	1 21	12 111 1+ + +212 111112 1 1	2 21 113 31112 1 +1 11 + 11+322132132 112 31 1 12 2 2 2 1 32 1
Australina muelleri	2 1112111 1	1 + + 1 + +	1 1+ + 1++1 1 1 +1 21+21 2 111111 1 21231 +1 22+ 11 +11
Olearia phlogopappa	1111+2 2	+1 1 +1+1 1 1	1+11 2 11+1 112+ 313 + 2 11 + 21 ++11121121+ 111++2212 +1
Dicksonia antarctica	2 212145 +	1+ 1 + 1+ 1 21 1	+ 112 2 41+1 +1+++ + 1+ 2++11 21 312 3+2 1+++ 23222 +24 122 132++ 323+
Senecio linearifolius	+211211 1	11 11 + 1+1 1 +	1 142 11111111121+1 +12 13 22111 111 1 1 +1 + 21++211+1 111 ++2+++
Oxalis corniculata	+ + 1	1 2 ++ 1 + + ++++1 +	1+ 11 1+ +++++ ++ + ++ 111+ 111+ + 1 + + + +
Dianella tasmanica	11 + +	+1++ 1+ 1+ 1113 + +	+1++ 11 ++++ + + + + 11+ + +++ 1 1 1 11 +
Lomatia fraseri	1 22	1 1 +1221 +11 +	11 1+ + + + 1+1 + + 1 ++1 + + +
Acacia melanoxylon	12	11 +1 11+121111+12111+2 11 +1	1 ++ 1 132 1 11+11 ++ 2111 2+21 11 1 2 221111
Prunella vulgaris	1+ +	1 + +11+21 +1+1 111+1 +1	++1++ + 11112 1++ + 1 ++ + + + + +
Prostanthera lasianthos	1 + +2	++ 1 1 121 1121 +	+11 + 1+2+1 1 11+2 1+ 11 +2 232 +21 1+14 2 2 21 11 ++1 + ++

Olearia argophylla	+ +	+2 2	4 2+2 1 111 1 2 121121221 2 2 1111 +21 31 2 413 +1222
Alsophila australis			1 1 1 1112+1+ 2 2+1111221 +21 212123121+ 1 1+ 22 + 11 ++ 211+
Histiopteris incisa	+ ++++		1 +1 1 + ++ + 1 1 1 ++ 1 ++ +++++1 + ++++1 21+11 1 1++1 1 1+
Olearia lirata	+ 1+	12 1 +	12 2 +2 ++21122+ 11 1231211 21 21+1111 12 1 + + 1++
Tetrarrhena juncea	1	1 1 1	1 11112+1323 12+2 +3211 41+12212+2222213 1 1++ 2 21 2+1
Eucalyptus regnans		+	1 1 +31+122422 233 233 23442213121543 41 434 32341 2
Blechnum wattsii	11 +	+ + 2 ++ 1 11 2++	+ 1 1 1 +21 1+ 1 1 2+ 32 21 2 2 1+2 2131
Correa lawrenciana	2 2	2 + 1 + 122 ++ + 1	1 22 221+1222+ 12 2 2 2 2 2 122 213
Lepidosperma elatius		+ +	1 + 1 1 2 1++1 1 1 + +1 1 2 +1+22+1 +
*Rubus fruticosus spp. agg.	+ ++	1+ + 11 11 +	1 +++ ++11+11 1 ++ ++ 1 111 1+ 1 1+ + 21 ++ 1 +
Sambucus gaudichaudiana	+ +		++1 + ++1+ 1 1+ 1 + +11 1 ++111+ +1 + +1 1 +11 1
Bedfordia arborescens	+	1 +2 1 + +	1 32+ + 1+1 +2 + + 2 231+2112+1 2 1 1++ 1 1+
Goodenia ovata		+	+ ++ 2 11 2 +11 2 2 11 + ++
Eucalyptus obliqua	+	1 1 1 1	1 21 11 1112 + + 1 1 221 +1 +2 + 2 1
Eucalyptus cypellocarpa	2	1 1 1	2 1 + 1 2 21 + 1 11 1 11 1 2 +
Pimelea axiflora	11	+1 + + +	1 1 11 12+ 1 1 1 2111 1 + 1+ 1 +
Gahnia sieberana		2 + 3	+ 1 1+ + + ++ + + +1
Blechnum cartilagineum	+		+ + 1+ + 2 + 2 3
Gonocarpus teucrioides		+ 1	1 ++1+ + + 1 1 1 +++ + 1
Luzula campestris spp. agg.	+ +	+ + + ++ 1 1	+ +++ + ++ ++ 1++ + + + + + + ++ + ++
Coprosma hirtella	+ 1++1 1	11 + +111 1+ 1 +	+1 + ++ 1 + ++++ +1 + +1 + 1++ 1 1
Ranunculus plebeius	++1 +	+ + + ++ 11+1+ + + 1	+ + + 1 +++ 1 1 + +1 +
Eucalyptus radiata		211111 12+++121121+ 32+11 12	31 1 1 1 + 1 1 1 + +
Platylobium formosum		+1 1+ +1 + 11 1 1 + +	1 11 2 +
Epilobium cinereum	+ 1 + 1	+++ 1+ 1+ ++++1++ 1	+ +
Asperula scoparia	++ 1	+ ++1++1+1 1111+1111+1++	1
Tetratheca ciliata		1 +1 11 ++ 1111 1	1
Gonocarpus tetragynus	1	+ 1 1++ 1+ 1 1 1 1+ 1	+ 1 +1 2
Lomandra longifolia		1 1 +11++ +	+ + 1 +
Senecio quadridentatus	+ +	+ 1 + + + ++	+ + + +
Eucalyptus dives		2 11 1 + +	2 + 1 12 11 1
*Trifolium repens	+++ +	2+22++ 1 2+1 +	+ 1 + +
*Rosa rubiginosa		12+ 11 1 ++	
Hymenanthera dentata	+	+++ 12	2
Blechnum minus	+ +	1 + ++ 11 + + +	+ + + +
Dichondra repens	+	1 + 1++11+ + 11+ 1+1	1 + + 1 +
*Centaurium pulchellum	+	11 + ++ + +	+ + 1 + + + +
Echinopogon ovatus	1 +	++ 1 1++ ++ 1+1 111	2 +

Table 4. Two-way table of Community 6.

COMMUNITY	6					
SUB-COMMUNITY	1	2	3	4	5	6
QUADRATS / SPECIES	111111111100110 000000000099009 000000000000000 112231223346234 492768090459154	0000000000000001000000000000000000000000000000000000 5566666555566551555999111115555555555961516919999999955 0000000000000000000000000000000000000100001000000000 5533221567621543667336676875671222451206603011446666150 29018908152535570641235481569282359727331997890601254	1111111111110 0000000000001 0000000000000 0101112212301 9163573564131	00000000100 1 99999999099 1 00000000000 0 66112223034 0 54066890577 2	000000000 1999949919 000000000 8333533551 2345426054	1100000000001000 1111111111211311 0000000000000000 3344141231184329 9 6876849706715408 4
Amperea xiphoclada	111+1 1 211 +	1 1	++ 1111	1 1 1		
Banksia spinulosa	11+ 1 1					
Burchardia umbellata	+1++ 1+111					
Cassytha pubescens	+ + 1 + +1 +	+ + 2	+	1		+
Drosera auriculata	+111 +1+1 +		+11	+	+ + 1	+ +
Eucalyptus consideniana	213 1 2113	2 1 1 3				
Goodenia lanata	112 1		11+	+		
Leptospermum juniperinum	+11222211221 11	+ 1 2 3 + 1	11 11	1 31 +		
Xanthorrhoea minor	+ 211 +1211	1 2 +1	+			
Xanthosia dissecta	+++ ++ + +		+ +1			
Pultenaea gunnii	2111++1132111	1 1 1 1	111			
Lomandra filiformis	+11+2+ 111+1	11 +1 1 1 ++	1 ++	+ +	+ +	1+ ++ +
Gahnia radula	121331213 121	1 11 1 1 1 21 +1 1 2	+ 111			1
Epacris impressa	1111+1111131	11+ 112+1 111+ ++ 1+ 1+211 1 42 1	+ 111 +	2 + 1 1	2 +2 3	+
Acacia mucronata	322221122111 1	4 23 2 121 + + 121	22 1211111+11	42321+ 222	312 22 +	1
Tetrarrhena juncea	2223312+3322322	11 21 1 131 3221 111 1 11112 +1232 14 +	23+2 32223323	33424222212 4	+222 2+	1 +1+
Eucalyptus obliqua	21122 2++2 2212	2 1 212+22 122 112122122 122+ +2 +1+3 1 1 1	2212221+2222 2	22+ 21+2212 2	22+ 1 1	2 1 +11 2111
Gonocarpus teucrioides	++ 1 ++1 1	1 1 11 111+++111111+1112 1+ 11+ 2++ ++21	111111+11111 3	+11 11 ++ 1	+	1 + ++
Goodenia ovata	2111 +12 + +	21+1 112 2 1111+21 212 +11+ ++ 1+1	11+ 22122+11	++2 111+ 11		+ 1
Eucalyptus radiata	1 1+1 1 2+1 11	1 + + 212 +2 + 1 1 21 2 31 111	12112 112222	11 1 2+ 121	122122113	11 ++
Viola hederacea	1++11 1+1+1++	1+1++1 111+ 1111111111111111111111++1111 1+ ++11111	11+111+1111++	+1++11 1+++1	1+11++1 +	1+ 1 1 + 11+ 1+11
Pteridium esculentum	22111 1 1+ 221+	1+1+1 11321112221211122211321 21+112+ 111211111+11121	223212+211111	112+3+111+22	21+1+11++1	2+ 111 +21+ 13122
Poa australis spp. agg.	211 1++2+++	2+1 111111111 12121 + + 1111 2111 + 1+3+112+1+ 1	11 1 1 +1	1 11 1 +	222111243	2 1+21211112 11 1
Cassinia aculeata	+1+++ ++1 1+	+2 ++++ 1 1111+ 4+11 1+ 1+++11 +21123+ + +	2132+++1++1++	+ +2 12+ 1+	+221+21+ 1	1++ + +1 + 1
*Hypochoeris radicata	+ ++++ ++ ++++	++ ++ ++ ++ 111 + 111++11 + +++ + 1++1 11	+++1++ +++++	+	1+ ++++	+1+1++++++ 1+
Lomandra longifolia	+1++1 +1+ ++	11 ++++11 ++1 1 11+ + +111 +21 1 2 + +1+ +1	1 + ++1	1+	+ 1511113	1111+1 ++11++1
Gonocarpus tetragynus	111+11+1111111	1 ++11+ + 11+11 + 1 1 1 ++ 21 1	1 11	3 + 1 1	11 1+111+2	2111++1++ +111
Olearia lirata	+1 + + +1 +++	+ + + + 1 1+ +11+ +1+ 1+1 2 +1 +1	1+1+111111111	+ 2 11 1		1 +++ + 12+22
Alsophila australis	++ + + ++1	2 1+ 111 +13111+ ++ 2 111+1 1 ++ 1	1+ +11111 12+	+ 1 +1 11	1 +	+1 1 2+
Dianella tasmanica	++	11 +++1+1 1+1 +++ 1 1++1+1111111 +11+11+ 2+ +	++ + 111	+ + + +++	11+2111113	+11 ++11 1
Eucalyptus cypellocarpa	+ ++ 1 2 1	21 + 1 21111132 1242111 11112+ 1132111 1111 122	2111112111+121	+111 1121+1	22221 2 1	++21 1+ +11 1 211
Coprosma quadrifida	+ +	1 1+1 ++ 111 1+ 1 1 1 1 +111 1 12+1+11+++	1+1122111 1+1+	+ 1 +	+1111	1 1 1++ + +
Clematis aristata		+ 1++++111+1111111++111+1 1 1+1++11111+++1+11+	1+++1111+2++	+++1 1 +	+1++1	+ + + 1 + 1+11
Acaena anserinifolia	+ +	+1+ 11 + 1 1+1 ++++1 +111+1+11111	1 2++++	+	1+11+2	1+1 1 ++ + 11+
Oxalis corniculata	+	+ +++1++ 1 + ++1+ + +++1++11++++11+1	+11++1 + +	+	1+++	++++++ ++ 1
Geranium potentilloides	+	+ + 1 1 1111+++ +++1 11+1+1 1++111+1111++1+11+	11211+1+1 +		11++1++	1+1 ++1++ 1++
Acacia dealbata	+ 1	+1+21+1121222 11122222211+11+133+221112111 2+21	1112 + +11 1	+1 1	1 21+221++	11 + 1111 11 3
Hydrocotyle hirta	++ +	1 1 + + +111 + 1++ ++1 ++1 1 111 1+1	+1++11++ +	+ +	1+++ 11	++++1++1+++ ++
Cassinia longifolia	2 11	+ + 1 122 112 +11 21+123 221211+ 23 1 21	1 1	++ 1	1+	+ 222221 12
Lagenifera stipitata	+ +2 1 + +	+1 + ++ +1 +111 1 ++11+++ + + +++1+1+++ + 1	+ 1++ ++		111 1	++ + 1+1+
Pimelea axiflora		1 1+ 2+ 111 111 1 + 1+ 1 + 1 11	1+11112 +1	+ 1 + 1	+	+ + + +
Billardiera scandens	1 + ++1 + 1	+ +1111 1 +++ + +11+1+ +1 + + 1+ 1 1	++ 1 ++	+ + +1	+	+ + ++++
Helichrysum cuneifolium	1 +	1+ + 11 + + + + ++ + 1+ 1	1+ 1+ 1	+ +1		
Culcita dubia	+	2 321 + +2 22 1 1+13 3 112 1 12	21 + +12222 3	1 2		+ 3
Blechnum cartilagineum	+	1 1 + +11 +121 1122 + 12 ++	+ +122112 +2	+		+
Pomaderris aspera	+	+++1 ++13 11 1 1 121112122112+11+1	1 11112 121 +	1+ 1 1+2 +	1 2+ 1	+ + 12

Prunella vulgaris		+ + + ++ +1 +++ ++· +	+1++ +1 1		1+++	
Senecio linearifolius	1	+ 1 + + + + 1 1+++11 +12+ 1 ++	1 ++ 1		1111+ 1	1 +1
Prostanthera lasianthos	+	+ + 1 + 1121+ 1+ + +	++11 +2	+ 1 + 2 +	+	
Eucalyptus viminalis		11324 ++ 32	12		+112	
Acacia melanoxylon	+ 1	1 1 + +1 + 1 +111+1+ 22+	111+ 1 1		112	+
Gnaphalium japonicum	+	+ ++ 1 11 + + 1 + +1+++ +++ 1+	+++ +++ +		++1+++ +	+ +++
Polystichum proliferum		1 2 1 12 1+2+1+1111	1++12 1		+1211 2	1 +1 +2
Stellaria flaccida		1 ++1 3+4 2 +	1++1 1		21 +	+ +
Polyscias sambucifolius		+ + 1 + + + 1 +1 1 ++ +++	11+1 + +1 1	+ 1 1 1	1 1++1+	1
Blechnum nudum	1 1+	2+ 2 2 112 1112+ 1 3+++	11 ++111+	++ +	2 ++	+ 1
Rubus parvifolius		+ + +1 +2+1++ +++	+ 111 11 1		+11 ++	+
*Rubus fruticosus spp. agg.	+	+ + ++ + 3+++ 2+1	+ 11++ ++++	+	++	+ +
Acacia verticillata	1 1 11	221 1 +	1 +111++1++	1 1 1		
Platylobium formosum	11 2	1 1 11 + 11 2 1 2	22 1 2 22 13	434 352 2 31	3	+
Tetratheca ciliata	1 + +	+ + + + 11 1 31	214 1+ + +	+ +21 1 11	1 2 1 1 1	+ 1
Pultenaea juniperina	1+1 1	1 1 1+ 1 2 + 2+1	11 2111111 2	222 11 21	22+1 1	1 +
Eucalyptus sieberi	22 13 1 2	3 221 31 21 2 2 2+ 2 + 1	1 1+	1+3 24 2+2 2	1	21 1 112 13
Lepidosperma elatius	1	1 1 2111+11	11+11 +11 1	1 1 + 1 +		
Daviesia ulicifolia	1	1 1 + 1 + 1 1 + 1 21	+	3 2++	11+1 11213	+2 1
Stylidium graminifolium	++ 1	+ 1 1 1 11 2 1 ++		2 1	1+2 11112	1 + + 1
Deyeuxia rodwayi	+ + +	++ 1 1+ +11+ +1 1 1 +	11 1 1 + 1	+ ++ 1	+ 1+111	+1 +
Olearia argophylla		+ + 1 + 1 1 +22 12 1 +	+ 1 1 1 +	1	+111	1 +
Olearia phlogopappa	+	+ + + + + 1 1 1	+ + ++	+	11+ 1 +	1+
Ranunculus plebeius		+ + +			+1 ++1	+ +
Coprosma hirtella		+ + + 2+	+		+1 1+1 +	+ 1
Stellaria pungens		+ 1 + + +			+111 1 ++	1+ + + 1+1
Eucalyptus rubida					21211	1
Luzula campestris spp. agg.		+ + + ++ + + + ++++ + +	+		+1+++ + ++	++++1 ++ + 1
Senecio quadridentatus	++ +	1+ ++ + + + + 11 + ++ 11+ + ++ + + +	11+ ++++	+	++++11+ ++	+++++++++ ++ +
Acacia falciformis		+ 1 1 1 1 1				2+ 1 + 114
Eucalyptus globoidea	1 1	21+ 212 +11 + 1 + 1 +	1 1			+22111 1+ 1+3
Hibbertia obtusifolia	1	+ +1 + + + 1 +111 1 + +			+	1+1+1 11 ++1++
Galium gaudichaudii	+	+ + ++ ++ + +++++ +++ ++ 11	+ +	+		+ 1111 ++++ ++ 1
Lepidosperma laterale	1++1 2	1 1++1 1 + 1 + + + + 1 + 1	2	+2		+ + +1 + + +
Poranthera microphylla	+ +	+ +++++ + + +	+ ++ +	++ + ++	+ ++	+ ++++++++++ ++
Dichondra repens		+ +1 + + 1 +1+ + +·11		+	+1	
Microlaena stipoides	1 1 +	1 1 2++ 1+ 1+3 +11 + 1 1 +1 + + 1 11	+		+	
Eucalyptus dives	1 +1	+ 112 2 1 1 11222 1 + 1 2 12		2 2	1 1 1212	1 +1 1 2
Leptospermum phylicoides	+ 2	+ + + 3 2 + 1 + 2 1 2 2 2 12		2 +		+
Exocarpos cupressiformis	+	1 +1 + +1 + +	+	++ +1 +1		+ + 1+ 1 1
Gahnia sieberana	11 11 11	1 + + +2 1 1+	+ +11 1 1	1 11+ +		
Bedfordia arborescens	+	1 1 +2 22 1 1++ + 2+1 + 1	+ 1 +	+ + 1 +11 +	1 1 1	+ 1 + + 2
Leucopogon lanceolatus		1 11 1 + +1 1 1 +			+	
Eucalyptus polyanthemos		11 1 1 2 1+ 1 2				2 1
Dianella revoluta	+ ++ +11 +	111 1 -+ 1 1 + +1	+	+ +	2	+ 1 ++
Acacia terminalis		1 +2 2 + +1 + +		1		1
Eucalyptus muelleriana		++1212 1 2 1 1				2
Histiopteris incisa	+	+ + + ++ +	+ ++ + ++			++
Dicksonia antarctica	+1	+ 111 +3+ ++1 + 1	++ +1		21 +	+
Asperula scoparia		+ +11 +			++ 1	1+1 1+ + 11
Eucalyptus macrorhyncha		+ 1				2 21 1 1
Persoonia confertiflora		1 + + + ++ +		1	+ + + + +	1 1
Monotoca scoparia	1 1	1 11 + 1 ++		2 1	+ 2	1 2
Glycine clandestina		+ + 1 + ++1 + 1+			+1	+++ 1+ + +
Hypericum gramineum	++	+ ++ +1 + 11 + +	+ 1++		+	++1 1 ++
Helichrysum leucopsideum		+ + 1	+ + +	1 + +	+	++ +++ +
Helichrysum scorpioides	1	++ +			11 +	+ + + + +
Stackhousia monogyna	+	++ 1 +	+	+	+1 +	+ 1 + +
Acacia obliquinervia	2	+ 1		2+ 1+ 1	2 1	11 12
Helichrysum dendroideum	+ 1 +1 +1	++ 1 1 1 +	1 1 1 +1	1		+ 1

Table 5. Two-way table of Communities 7 and 8.

COMMUNITY	7	8	
SUB-COMMUNITY	1	1	2
QUADRATS	00000000000000000000000000000 44443411944422444433333334944 00000000000000000000000000000 00560185520033134200235555540 18008614632985797757312315644	11100000000000000 11155555566666666 00000000000000000 11233466700012012 58018458023663581	00000 000000001100000000000000000000000000000000000000 0000 66666 661111151155555555555555555555555555557666666661155 5555 00000 001010000000000000000000000000000000000000000000 0000 00002 210903501255000112233460111112622233301122311199937 7444 14780 645949944903567197947841234670714803527924212553613267
SPECIES			
Eucalyptus radiata	1+13 1 +2 12 1 1		+ 1 + 1 +
Coprosma hirtella	111++1 1 1 + + 1		+ +
Eucalyptus mannifera	111+ 2 2121121+1111 11 1		+ + 12
Tetratheca ciliata	1111111 111 11 ++1111 21	+	1 + +1 1
Platylobium formosum	111112 2 111 112+ 111 + 1 2		+ 21 +1 1
Daviesia ulicifolia	2 21 22 +2 1+ 3		++ + + 1 + 2 2 +
Monotoca scoparia	+ 112 1 122 11 111+ 2+2	+	1 1++ + + 1+1 1 1+ 1
Eucalyptus dives	121+32222213 121+121 12113+		+1 + 3 22 2 11 2
Daviesia virgata	121 2 +2 2 1 2 231	2	1 +2 3 +11 2 3
Acrotriche serrulata	++1+ + + 11111 2	+ +	+ + + + + + + +
Dillwynia retorta	22 12 2 1 11111 2 3	+	1 + 1 1 1 1
Exocarpos strictus	+11 + 1+++1+ +1+ 1 +1+1 1	+ +	+ + 11 + 1+ 1+ 1 +
Stylidium graminifolium	+ ++11+1111 + 1 1 1 1 1	+ ++	++ 1 1+ + 11 + 11 1 + + + 1
Persoonia confertiflora	+++1++ ++++ ++1 1++++ 1+1	++ +	+ 1+ 1 +1+++1+ ++ + + + + + ++ ++
Pimelea linifolia	+1+++ 111+111 11 11+1	+ + + +	+ + +1+ 1 +++ 1 + + +1+++
Gonocarpus tetragynus	211112+1+111 +11+ 1+++ +1	1 + + +	+1 1 111+ 1+ 1 111 +1 ++ 1+1+ +1 1 + 1
Cassinia aculeata	21 211 21 +++ + 21+ 1	+	++++ ++ + + 1++ 1 1 ++ ++ 1 1+ +
Acacia dealbata	+1+ ++2++ + +1 11 11 12	+ 1	1+1 ++++ 1+1111+ 2 2111 11 221 12 2 2 1 1
Pteridium esculentum	2212 11 +121 2 + + 1	22 1 1 +	1 11++1 2++2+ 1 1 +1 22 2
Dianella revoluta	++1+11 ++11+111 1 1111 111	+ + + 1	11+++11 ++1 11+1 111++2 11 + + +1 + 11+ 1
Viola hederacea	111+++1+ + +1 1 +1	+1 1 1 11 +	1+ ++++ 111 +1 +1 1 +1 +1+ 11 1 1 +
Hardenbergia violacea	2 1 +1+ + ++ 1 1 ++ 1 +	+++ 1+1 +	11 +1 +++ +11+1 1 1 ++ + ++ 11 +++ ++
Eucalyptus macrorhyncha	+ 1 22 3 1112 1	1 1223	11 + 112212 + 1211 2 3 1 2 1 2 1 21 31+21 + 2
Poa australis spp. agg.	211122 22221111221121222121	211112111 111+11+	112 2 + 1 1+ 11 111212+1211 11+111+1221111+ +11+121 +111
Lomandra longifolia	+11 +1+11111+1+1+ 1111111 1	1+11 11 + 1 1	1+1+1++11 +11++1+111121 1+1+111+11 +1 1 + 111+1+1 11111
Hibbertia obtusifolia	+1111 +11111+1111 1+11 1111	+1111 + 1 11 1+	11 +1 11111111+ ++1111+1 11 1+ 1 1 1 1 11111+11 + 1 1
Cassinia longifolia	+ 1 +2 2 2 ++1 23	22 222 2212232+	+2122 121+ 1+ 222+12+1222 2 12 2111++22+212121+1 12322+3+3
Hydrocotyle hirta	+11 ++1 + + + +	++ 11111111+11+11	1 ++ ++ + +1+ 1+1 1111 11 11 + +1+11 + + 1 1+ +
*Hypochoeris radicata	+ + ++ + + 1	+1211 1 1 1+11+1	+1++ +++ ++ 1+ 11+ 1 +111211++1 21 +1++ + + 1+
Lagenifera stipitata	++ + + ++	11111111 ++ + 1	++ 1++ ++ 11+ 1+1 1 11111111+++ 1+ 11 1 + ++ 1 +
Galium gaudichaudii	+ + ++ + +	++1+ 11++ + + +	+ + ++ ++ ++ +11 ++ + 1+ + + ++1+ +
Lepidosperma laterale	+ + 1 1 + +21	++++ 1++111	+ 111 +2 +1 11 12112++112 + 2 ++ + + 1 1
Senecio quadridentatus	+++ + + + +	+ 1+++ 121+ 12	11+ +++ + ++1 1 1+ 1 + + 1 + +1+ +
Eucalyptus polyanthemos		+ 212 +11+1221 1+	1 11 11 + 11 1221 +122+ 21 22221 1+21+112+ 1+ 1
Eucalyptus globoidea	+	112 22211	1 1212 1 2 + 12+ 1 2 + + 22 + 1 22 1 1
Stypandra glauca		1+11 +1 1 1 22	11 +1 11 12+++ 12 2 11 1322 2+11211 121111 22 1 1 +
Hypericum gramineum	+ + 1	++1+++1++ +1++	+ ++++++ 1+ 1++ + ++111+11 1+ 1+ + + 1 + ++ +
Microlaena stipoides	1 + +	1+12+1+ ++ 21 2	1 + + 1 + ++1 +1+ 21++1+ +11 1 1+ 1
Phyllanthus hirtellus	+	+1+1 1 +1+ +	1 + 1 + +1 1 1 + 1++++++1 1 1+ 1 2++
Eucalyptus cypellocarpa	+ 111 1 1	21 1 11+2 +	+211 1+ 11 1 112 1 1 1 + 11 2 + 1+
Billardiera scandens	+ +	11++ +++ +++	+1 ++++ + + +++ + 1 + + +
Eucalyptus muelleriana		2 1 2 2	2 2 1 2 1 2 2 2 3 32 1 23 22
Acacia terminalis	1 2 12111	1 + + +	112+22 +12+ 11 + + + + 1 + + 21++2 + 1
Acacia falciformis	31	21 +2	+1+ 111 +22 ++ 2 11 12 1 1 + 11222 2 23
Eucalyptus sieberi	1 2 1 +	2 + 1	221 22 2 32233 1 1 + 2 1 12 1 2 21 22 +
Gahnia radula	2	+ 1 +	+ 1 3 1+ 1 2 13121 +1 1 + ++ 2
Epacris impressa	+12 1 1 111 14+	1+ +	11 1 +1 1 + 1 1121 2 + 1 11 +1 + +1 1

Eucalyptus radiata
Coprosma hirtella
Eucalyptus mannifera
Tetratheca ciliata
Platylobium formosum
Daviesia ulicifolia
Monotoca scoparia
Eucalyptus dives
Daviesia virgata
Acrotriche serrulata
Dillwynia retorta
Exocarpos strictus
Stylidium graminifolium
Persoonia confertiflora
Pimelea linifolia
Gonocarpus tetragynus
Cassinia aculeata
Acacia dealbata
Pteridium esculentum
Dianella revoluta
Viola hederacea
Hardenbergia violacea
Eucalyptus macrorhyncha
Poa australis spp. agg.
Lomandra longifolia
Hibbertia obtusifolia
Cassinia longifolia
Hydrocotyle hirta
*Hypochaeris radicata
Lagenifera stipitata
Galium gaudichaudii
Lepidosperma laterale
Senecio quadridentatus
Eucalyptus polyanthemos
Eucalyptus globoidea
Stypandra glauca
Hypericum gramineum
Microlaena stipoides
Phyllanthus hirtellus
Eucalyptus cypellocarpa
Billardiera scandens
Eucalyptus muelleriana
Acacia terminalis
Acacia falciformis
Eucalyptus sieberi
Gahnia radula
Epacris impressa

Eucalyptus melliodora	2	11 1 22 122	3 1 1 1 2 + 1 1	Eucalyptus melliodora
Leptospermum phylicoides	1 + 1	+21324+ 32	+ 411 12 2 13 1 + +3	Leptospermum phylicoides
Geranium potentilloides	111 1 + ++ 11	1 1111111+1 1+1	+ 1 1 1 +11+ ++ + ++ 1+ + 1	Geranium potentilloides
Oxalis corniculata	+ 1	++11++1++1 1+ ++	1 ++ + + ++ + 1 + 1 + + + +	Oxalis corniculata
Gnaphalium japonicum	+ ++	+ ++ 1+1+++ +	+ 1 1 + ++ 1 1++ + + + +	Gnaphalium japonicum
Dichondra repens	+	1+111111++1 +11	1 + + + + 1 1	Dichondra repens
Cheilanthes tenuifolia	+ 1	++21 + 2+1 1++	++ + 1 + + 2 + 1+	Cheilanthes tenuifolia
Luzula campestris spp. agg.	+ + + ++	+++ +1 +1 ++++	+ + + + + + + 1 1+ +	Luzula campestris spp. agg.
Cymbonotus preissianus	1 +	+11+11 +11 1	+ + 1 1+ 1 1	Cymbonotus preissianus
Veronica plebeia	+	1++1++ 1 ++	1 +1++ + + + 1 + + 1+	Veronica plebeia
Glycine clandestina	++ + +	112++111+++ + +	+ + + + + + +	Glycine clandestina
Acacia mearnsii		112332 22 + ++	+ 2 1 +++ 1	Acacia mearnsii
*Cerastium glomeratum		+ + + ++ + +	+ ++ + +	*Cerastium glomeratum
Acaena anserinifolia	1 1+ + 1 11	++ 1+ + 2	1 + 1+ + 1	Acaena anserinifolia
Acacia melanoxylon	+++ + + 1 1	1 1+ + 1	+ + 1+ 1	Acacia melanoxylon
Poranthera microphylla	1 ++ 1	1+1 + + +	+++ + 11 ++ + 1+ +	Poranthera microphylla
Plantago debilis	+	111 1 11+		Plantago debilis
Echinopogon ovatus		111 + 1+ +	+ ++	Echinopogon ovatus
*Centaurium pulchellum	+ + ++ + +	+1+ + +	+ + ++	*Centaurium pulchellum
Asplenium flabellifolium	+ + + +	+ + +++	++ + + +	Asplenium flabellifolium
Stellaria pungens	++1 + 1 1 ++ + 1 1	+ 1 1 +	4 + 1 1 1 + + 11	Stellaria pungens
Dianella tasmanica	1111 1+1 1 1 1 +	+ 1	1 1 + + 1 1+	Dianella tasmanica
Gonocarpus teucrioides	1	1 1 +	+ + 1 +1 1 2+ 1 +	Gonocarpus teucrioides
Pomax umbellata	+ +	++++ 1 ++	1 2 + 1 1 1 1 1 111 + 1	Pomax umbellata
Coprosma quadrifida	1 11 + + +	+ ++1 +	+ + + + + + 1	Coprosma quadrifida
Clematis aristata	11 + 1 + +1	+1+ 1 + +	1 + ++1 + + ++ + + +++ 1 1	Clematis aristata
Asperula scoparia	1+1 + 1 +1	+ +	+ + + + +	Asperula scoparia
Olearia myrsinoides	1 1 + 1 1 +	+	+ ++ + 1 +	Olearia myrsinoides
Lomandra filiformis	+ +++ + 1 ++ ++	1+1+	+ + 11 ++11+ + ++ 1 1 + 1+ 1	Lomandra filiformis
Danthonia pallida	21 21 +1	1 1	11 12+ 1 11 +1 + 1	Danthonia pallida
Eucalyptus goniocalyx	2 1 11 1	222 22	32 1 1 11 2	Eucalyptus goniocalyx
Eucalyptus consideniana		11 + 1	1 1 1 1 2 + 3	Eucalyptus consideniana
Xanthorrhoea minor		+	1 2 1 1 + 1 + + + 1	Xanthorrhoea minor
Eucalyptus obliqua	1 22 + 1	+ 1	1 1 1 1 1 3 1	Eucalyptus obliqua
Goodenia ovata		11 + 2 +	1 2+ 2 1 +2 1 +2 3 1	Goodenia ovata
Acacia mucronata	12 2 + 1	+ +	1 + +	Acacia mucronata

Table 6. Two-way table of Community 9.

COMMUNITY	9				
SUB—COMMUNITY	1	2	3	4	
QUADRATS / SPECIES	000000 222222 000000 336788 699023	11111111111111111111 11111111111111111111 00000000000000000000 44204423344133301225 45672653501612959780	000000000000000000000000 00000 333331155555555555111111 11111 000000000000000000000000 10000 022359613444000035687699 06998 645042409013392821093316 02708	00 77 00 12 20	
*Aira caryophyllea	+	+ 1 + 1+1+ + 1+	+ + +		*Aira caryophyllea
Deyeuxia quadriseta		+ 1 +++++ 1	+ 1		Deyeuxia quadriseta
*Sonchus asper		1+ ++1++ 1+++ +++			*Sonchus asper
*Sonchus oleraceus		+++++++ + +++ 1+		+	*Sonchus oleraceus
*Trifolium repens	+ +	+ 1 ++ + 11+ ++	+ ++		*Trifolium repens
Agropyron scabrum		1 1111++11 ++1+	+		Agropyron scabrum
Hydrocotyle laxiflora		+1+++ 1+1+1 1121	+		Hydrocotyle laxiflora
Crassula sieberiana	+	+ ++ + ++ + +			Crassula sieberiana
Eucalyptus macrorhyncha	1 1	2 11 11+11 +	1 + 1		Eucalyptus macrorhyncha
Danthonia racemosa	+	+1 2+1 1+ + 1 ++ +			Danthonia racemosa
Dichelachne crinita		+ 1++ 1+++ 1 1	+ +		Dichelachne crinita
Geranium retrorsum		+ 1 1+11 +11+			Geranium retrorsum
*Trifolium campestre		+1 1+1 1+11 +			*Trifolium campestre
Daucus glochidiatus		+++++ + 1 + ++			Daucus glochidiatus
*Vulpia bromoides	+	+ + ++++ + +++			*Vulpia bromoides
Dichelachne micrantha		+ 1 1++1+11 1++++	++		Dichelachne micrantha
Rumex brownii	+ +	111+111+11++ +1+++++	++ +11+11 1		Rumex brownii
Plantago debilis	+	+ + 1 + 1++11++1	1111+ +		Plantago debilis
Cheilanthes tenuifolia	+	++11 1 +1+++1+ ++	+1 11 1		Cheilanthes tenuifolia
Glycine clandestina	1 +	+1 ++ +11111+ +11+++	+ ++1 + +1111 +		Glycine clandestina
*Conyza bonariensis	+++	1+1+1++1 + +11+ ++	+ 1 + +++1 + +	1+	*Conyza bonariensis
Echinopogon ovatus	+ + +	11+ 1 1+11111+12111+	+ 11 + + +1+ ++ + 1		Echinopogon ovatus
*Cerastium glomeratum	+ ++	+ + + 1+++ + + 1++	+ + + + +	+1	*Cerastium glomeratum
*Anagallis arvensis	1++ +	++++++1++ 11++ 11+ +	+ + + +	+	*Anagallis arvensis
*Hypericum perforatum	1+ 1	212+ 11212 1 2 +	1		*Hypericum perforatum
*Rosa rubiginosa	1+1 11	+11 +1 ++1+ +1	1+ 1 + + +	1	*Rosa rubiginosa
Hymenanthera dentata	1+1111	+ 11+ 11 ++111	+ 1+1 1	1	Hymenanthera dentata
Eucalyptus melliodora	21111	1 1 22+11+2+ 1 111+	1 1 1 1	1	Eucalyptus melliodora
*Cirsium vulgare	+++ 2	+ +++++1+++ +1++1	+++ +++1 +	++	*Cirsium vulgare
Acacia mearnsii	1 1+1	1121+ 1 1212 1 2 +	143 +211	1	Acacia mearnsii
Eucalyptus bridgesiana	1 113	+ 2 22 1 +1 2111	111 112 2 1 2111 121 221		Eucalyptus bridgesiana
Prunella vulgaris	1++1	+ +1 +++11111+	+ ++ 1 1 111 ++111+ +1	+	Prunella vulgaris
*Hypochoeris radicata	++11	+++ 1+111111111111+++	+ +1 + 1 ++1 21221++++++ ++++	+1	*Hypochoeris radicata
Pteridium esculentum	+42 1	1 +21 12+ 1+123111+	131+111 1 11211 1111 +1 11+1	12	Pteridium esculentum
Acacia dealbata	21111	+ 111 1111 11+	13112111 +1 1 1111 11 1 232	1	Acacia dealbata
Geranium potentilloides	1++ 1	1 11 1 ++ +	+ 1+1 +121+111+21+1++1+ +1++	1+	Geranium potentilloides
Oxalis corniculata	++1 11	1++++11+++ 1++111+ 1	+ + 11+11 ++11+1++1++ +1+ +		Oxalis corniculata

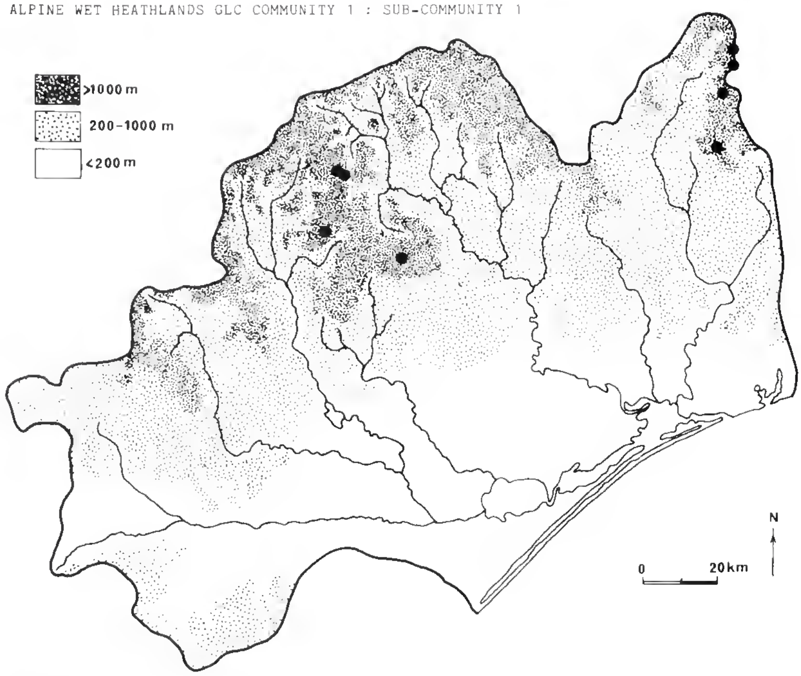
Acaena anserinifolia	1+1 11	+1 + 11 11+1+1+1+	+1112+ 1 + 11+2111 111+ 11	+	Acaena anserinifolia
Leptospermum phylicoides	2 231	4 1 2 1123+1123212	2 23 13 1 123333224 +2122	1+	Leptospermum phylicoides
Dichondra repens	1++ 11	+1+ + 1++1111+++11+	+1+111++11111111111+11+1 1++		Dichondra repens
Eucalyptus viminalis	21 +1	1 1 2 22 +	2312212 21 1 + 2112 11	+	Eucalyptus viminalis
Acacia melanoxylon	1111	+ +1+++ 1 111	2 11 1 + 11+1 11+21+ +1 1	1	Acacia melanoxylon
*Rubus fruticosus spp. agg.	21231+	+13++++1+1 ++	++ +1+ +1 +++++1+ +2 ++	21	*Rubus fruticosus spp. agg.
Clematis aristata	++1	++++ + +111+ +	+1+ 1++ + + +1 +++1 + +1+++		Clematis aristata
Poa australis spp. agg.	3 2+	1 111+122111212+1211	1111+1112111 2+2111 2+1 1 1 2	13	Poa australis spp. agg.
Cassinia longifolia	111	1 2+22 2 21 211+1 2	+ 1 12 1211 1 11+2 1 ++211		Cassinia longifolia
*Centaurium pulchellum	1++	11 1+1 ++1+1+ +++	1+++++ + ++ + ++ + + +		*Centaurium pulchellum
Urtica incisa	+ +1	++ +111 + + ++1++	+ 1 112 +++ + + 1		Urtica incisa
Gnaphalium japonicum	1 + +	++ + +++++ ++++++++	++++1+ 1+ + 11111 + + ++		Gnaphalium japonicum
Eucalyptus radiata	1 2	1+ 2+ 2 2 221	11 1221 1 1+ 1 1		Eucalyptus radiata
Adiantum aethiopicum	+ ++	1 11 1 1 1121	1 + 1 11 1111221221211 +1111	+	Adiantum aethiopicum
Carex appressa	1 1	1 + 1+++ 1 1+1 +1	2+121 1+ 1 2+11 +	1	Carex appressa
Hydrocotyle hirta	1 +	+ 111 + 1++2++	+11 1 1 +11 1122 1+11+1 11++	+	Hydrocotyle hirta
Stellaria pungens	+ +	1 + +11 1 +111	1 11 1 1+1+1+ +1 + ++ 1		Stellaria pungens
Hypericum gramineum	+ 1	11 1 ++ 1+1+ +++	+++ 1 1+ 1+ + + +	+	Hypericum gramineum
Galium gaudichaudii		++++ ++ +1 +++ +	+++ 11 + 11 + ++ +++++		Galium gaudichaudii
Luzula campestris spp. agg.	+	+ ++++1+ ++++++	++ + 1+ ++ + 1 + ++ +		Luzula campestris spp. agg.
Microlaena stipoides	+	++ 11 +1+1 +1 ++++	2 + ++1 21+ 222 1		Microlaena stipoides
Rubus parvifolius	+11	+1 1 1 +1+1+++	+2+12 + +11+ ++	+2	Rubus parvifolius
Stellaria flaccida	+	1 ++ 1 11 ++	1 1+ 1 11 111++1 +1+ +		Stellaria flaccida
Coprosma quadrifida	++	1 1111	1+++1 + +1 +1111+2 11 1	+	Coprosma quadrifida
Pomaderris aspera	+1 1	+ +++2 +1	2221+31 111+111+1211111+ +2 +2	1	Pomaderris aspera
Viola hederacea	1	1+1++11+	1++11+ 1+1 2 12111+1 11111		Viola hederacea
Cassinia aculeata		+ +++++ 1	++1+3 2 + 1111 + +1+1 111	+	Cassinia aculeata
Lagenifera stipitata	1 +	++ + + +1+11+	+ 11++1 1 111 1 + 1 + +		Lagenifera stipitata
Lomandra longifolia	+11	11 + + 2 ++	+ 2+ ++ 1 1 11 12122111 + 111		Lomandra longifolia
Lepidosperma laterale	+	+ +1 + 1 +	+ 1+1 1 1 111221 1 11		Lepidosperma laterale
Blechnum nudum	1 +	+ ++	+1+ + + 2 112121+ 1+ +	+	Blechnum nudum
Prostanthera lasianthos	+	112+11	11+ + 1+12 1+1+1+ ++	+	Prostanthera lasianthos
Poranthera microphylla	+	+ + + +1 1+ +++ +	+1 ++++++ +++++		Poranthera microphylla
Pimelea axiflora		+ 11	1 11 1++++1+++ + 1		Pimelea axiflora
Eucalyptus dives		1 2 1	1 21 + 11 + 21 1		Eucalyptus dives
Dianella tasmanica		1	+ + +1+ + + ++ ++		Dianella tasmanica
*Dactylis glomerata		+		12	*Dactylis glomerata
*Galium aparine		1		++	*Galium aparine
*Plantago lanceolata		+ +		+1	*Plantago lanceolata
*Rumex crispus		1		11	*Rumex crispus
*Acetosella vulgaris	1	1+ 1	+	11	*Acetosella vulgaris
*Vicia angustifolia				++	*Vicia angustifolia
Phragmites australis			1	+2	Phragmites australis
Acacia floribunda			+	1+	Acacia floribunda
Culcita dubia	1	+2 1	3 1++ + 1		Culcita dubia
Senecio quadridentatus		+ + 1 1+ + +	+ + + + + +++		Senecio quadridentatus
Gonocarpus tetragynus	+ 1	1+ 1 1 1	1 1+ + 1 1		Gonocarpus tetragynus
Asplenium flabellifolium	1+ +	+ 1+ ++ + +	1+++ 1 1+1 1 + +		Asplenium flabellifolium
Bursaria spinosa	1 1	11++2 1 1+ 1+	1 +1 1 + 1+1+1 11		Bursaria spinosa
Senecio linearifolius		1+ + ++1 +	+1 1 1 1 + +	+	Senecio linearifolius
Eucalyptus polyanthemos	1	1 1 + 12	+11 + + 211		Eucalyptus polyanthemos
Hibbertia obtusifolia	+	1 + 1 1 +	1 + 1 +++		Hibbertia obtusifolia
Veronica plebeia	+	++ + + +++	1 + + + + +1++ 1++	++	Veronica plebeia

Table 7. Two-way table of Communities 10, 11, 12, 13.

COMMUNITY	10	11		12	13	
SUB-COMMUNITY	1	1	2	1	1	
QUADRATS	00000000000000000000000	00000000000	000000000000000 000	0000000000000000000000000000000000000000000	000	
	88888888888888888888888	77777777777	777777777777777 777	8888888888888888888888877777777777788877777777	877	
	00000000000000000000000	00000000000	000000000000000 000	0000000000000000000000000000000000000000000	000	
	25043322221104333322404	13433310000	32222222111100 001	1554432211000011123555555555444333444443354	545	
SPECIES	132676764316531985382045	44953018762	2976532186530 95 419	841921509387657049056654321654862387219778	038	
Glossodia major	+++ 2 + ++++1 +			+		Glossodia major
Lomandra filiformis	+++21 + 1 1 1 1 + 1	+	+1 + +			Lomandra filiformis
Correa reflexa	+11+ +++ + ++ +					Correa reflexa
Dillwynia glaberrima	1 11 +1 1111 1+	+	1 +	+		Dillwynia glaberrima
Amperea xiphoclada	+++ +++ 2+1+ + + + +	+1 +	++ 1 11 1			Amperea xiphoclada
Bossiaea heterophylla	11 1 111 +11 + 1			+		Bossiaea heterophylla
Brachyloma daphnoides	21 1 21 + + + 221+			+		Brachyloma daphnoides
Caustis pentandra	111211121211112 1 11 1					Caustis pentandra
Hibbertia fasciculata	1111 12 2 121+12 2 11					Hibbertia fasciculata
Hibbertia virgata	1++1+1 11+ 1 1111 +		+	1		Hibbertia virgata
Leucopogon ericoides	11132+322212222 1+11 11	+	2 1			Leucopogon ericoides
Eucalyptus nitida	12 122211122111 2111 1			2 1		Eucalyptus nitida
Bossiaea cinerea	22121122112121+111111+1			+		Bossiaea cinerea
Leucopogon virgatus	+1+11+ 112+1121+1+112+ 2					Leucopogon virgatus
Acacia oxycedrus	11 11121++11111 111++++2					Acacia oxycedrus
Banksia marginata	22111+1112211111111 +12		1 1 1 1 1	1 2		Banksia marginata
Leptospermum myrsinoides	43242 4+1144343 23211+13					Leptospermum myrsinoides
Monotoca scoparia	2122+2212 12111211121 1	+	1 1 1++	1 + +		Monotoca scoparia
Dampiera stricta	+1+1 12 1 + 1 11+		++ +	+ + +		Dampiera stricta
Schoenus brevifolius	1++ 112+ 1 12			3 11 2		Schoenus brevifolius
Leptospermum juniperinum	1++2+ 1+ 1111 2+11 111		+ + 2 + + +	2 +		Leptospermum juniperinum
Drosera peltata	+ ++ + + 1+ 1++1	++ +	+11+1+ + + +	+ + 1 + + + ++		Drosera peltata
Olearia lirata	+	+ +1+3++ +	+1+ +	1 1+ +		Olearia lirata
Clematis aristata		+++11 1+1	++ ++ + +			Clematis aristata
Lepidosperma laterale		+1 1+ +2	++ 1+ + 1 1	+		Lepidosperma laterale
Hibbertia aspera		1111 + 1	11 + 1 +1 1 1			Hibbertia aspera
Opercularia hispida		++1 1++	++ +++ + +			Opercularia hispida
Hypericum gramineum	+	+ + + ++ +	+ 11 11 ++++ +	1 +		Hypericum gramineum
Galium gaudichaudii	1	++++++ +	+ + +++	+ ++ 1+ + + +1+++ + +	++	Galium gaudichaudii
Eucalyptus sideroxylon		+ 1 11 +	1 1 11 2			Eucalyptus sideroxylon
Hibbertia obtusifolia		1+ ++1+ 1	+1++ + 11 ++111			Hibbertia obtusifolia
Eucalyptus cypellocarpa		121+12 2	1 11 1 11 1+1++			Eucalyptus cypellocarpa
Viola hederacea	+	+111+11+11	+1 1+1 1 1+ 11++ 1	1 + +++ ++		Viola hederacea
Cassinia longifolia		1++12112	1 + 1 31 +11 1	+		Cassinia longifolia
Billardiera scandens		++1+ +++++	+11 +1++1++ +	+		Billardiera scandens
Eucalyptus globoidea	2 + 2	232122 12	22 21222222 1122 2			Eucalyptus globoidea
Acianthus exsertus	+ +++ ++	+1+ ++++	1 1+ ++ ++++	+ 1+++ 1+ 1+1 1+		Acianthus exsertus
Leptospermum phylicoides	1	2 1++ 31	1223 11311	+ 12 + 1 +		Leptospermum phylicoides
Gahnia radula	+	2 1 +1	12 1 1 21 2 1			Gahnia radula
Xanthorrhoea minor	+ + 1	+1 111 +	111+ ++211111 1+			Xanthorrhoea minor
Persoonia linearis		11+ +	11 ++++++++++1 +11			Persoonia linearis
Tetratheca pilosa	+ + 1+	1+ +	1111 + +21 111+112			Tetratheca pilosa
Stypandra glauca		+ 1	1 21211+ 1 11 12			Stypandra glauca
Phyllanthus hirtellus	+	1 +	1+ 1 11 + 1 ++11+1	+ +		Phyllanthus hirtellus
Lomatia ilicifolia			1++++ 1+1+ 1 ++1			Lomatia ilicifolia
Eucalyptus sieberi		1	1232321+2 1 2 2+2			Eucalyptus sieberi
Craspedia glauca			1++1+111+ ++11+11	1 ++		Craspedia glauca
Acacia genistifolia	1 2 ++	1	1 2+11+ 1111 1	1 1 2 + 1		Acacia genistifolia
Acrotriche serrulata	++ 1 + 11+1	1+ 1+ +	111221 11++1111 11	+++ 1 1 + + ++		Acrotriche serrulata
Epacris impressa	11121+231112111111111112	11+1+	11+111111++111+ 11	+ 1 + + 1		Epacris impressa
Banksia serrata	11 121+1121211221 2121	+3+1 1	2 +3 21	3 1++22 2 1 +1 3+2 2 2		Banksia serrata

Pteridium esculentum	13 1321 + 2+ 2+2111422	2134243222	124122224223 13312	1122 22231242 413 12221323221123 1 + 1	2	Pteridium esculentum
Lomandra longifolia	++1+1+1++++1+ +11+11 11+	11111+ +	1111+1111+1++++1 1	1111+122++11+112 221121111+221112 +1 1		Lomandra longifolia
*Hypochoeris radicata	++1 + + +++ ++11+1	+ +1 + 1+1	1 111111+ +++ ++ +	+1++111+1+11+1 3111+11+11++++++ +1 ++ ++	++	*Hypochoeris radicata
Dichondra repens	+ 1+	++1+ 1	+ 1 + +++	+211+11111+11+ 1111111111 +1+11+1 +11+ 1	+ 1	Dichondra repens
Hydrocotyle hirta	+ +1++	111 1++ +	11111111 +1 +11+	1 11111+1+++12+1 111+11+1 11 1 + +		Hydrocotyle hirta
Senecio quadridentatus	+ + +11	++ 1 +1+	+ + + 1 1++++++	1 + 11 ++ ++ + 1 1 + ++	1	Senecio quadridentatus
Poa australis spp. agg.	1 + + 1 1 1 +1+ 11	+1 1+1 1 1	1+ 111 +1+ +1+	+1 2++ + +2122 + +13221+11 +		Poa australis spp. agg.
Lagenifera stipitata	+ + + + + 1+1	+1111 ++1+1	1 1++111 11+1+1++	++11+1+ 111++11 ++ 111 1+1++11 +		Lagenifera stipitata
Oxalis corniculata	+ +1+++	+ + +++	+ ++++ + ++ +	++++ ++1+1++++111 1 ++++ 1++ +++	11	Oxalis corniculata
Gonocarpus teucrioides	+ 1 1	+111 1+	11+1+11111 111+111	++11 1 1 + ++ + ++ +11+ +11		Gonocarpus teucrioides
Microlaena stipoides	+ 1	++11 11111	1 22 11 +1+1 +	1 + 1111 +11+ +1 +1+11+1 1 +1		Microlaena stipoides
Acacia mearnsii	1 1+	11 12+	1 11 2 111	+ 1 11+ 2+1++111 + 1		Acacia mearnsii
Acacia longifolia	+	1+ 3	+2 1 11 11 1 1	+1 +1 + 2 21 +112+ 1 +21	12	Acacia longifolia
Veronica plebeia		+ +11+1	11 + 1	+ + + ++ + + + 1		Veronica plebeia
Luzula campestris spp. agg.	+	++++ +++	+	+1 +++ +1++ +++ ++ ++ + ++++		Luzula campestris spp. agg.
Glycine clandestina	+ +	+ +++	+ +	+ + 1++++1++ +1+ ++ ++++ 1+		Glycine clandestina
Lepidosperma concavum	1 + + 1 1+++12212	+2	1 1 + 1	2221+1 2 31 1 1 321111 1 12+	+	Lepidosperma concavum
Eucalyptus viminalis	+ + +1 +11 21 + 1	+	+1	1 2 2 11+21 11 12 1 2 1 +		Eucalyptus viminalis
Centrolepis strigosa	++ + + +++ +++	+		+ ++ + ++++ + +		Centrolepis strigosa
Crassula sieberiana	+++ + +1 ++1+++	+		++++++1+1++++11+++ 1 ++ + + + + + +	+ +	Crassula sieberiana
Juncus pallidus	+		+	1 + + +++11+ + + + 11+ 1		Juncus pallidus
*Conyza bonariensis	+ +	+ +	+ +	+++ ++ + +11++ + + ++ + +	+	*Conyza bonariensis
*Sonchus oleraceus	+ +	+		+++ ++ + + + + + ++ + + + + +	++	*Sonchus oleraceus
Tetragonia implexicoma				+11+12 21 + + 13 1 122+11 +11+ 21	+2	Tetragonia implexicoma
Acaena anserinifolia	+	+ 1	+ +	+ ++++ + + 1+11 + 21+ +	+	Acaena anserinifolia
Scirpus nodosus	+ +1	1		12111+1+1+ 111 1121111232313 2322112 11212	111	Scirpus nodosus
Baumea juncea	1			21 1 +3 2 11112122 233 + 1		Baumea juncea
Melaleuca ericifolia	+ 1	+	1	3 12 2 1 1 1 +4 2 3 +1432 +3 322 11		Melaleuca ericifolia
Banksia integrifolia				33312 2 1 22 21 +112 2+ 121222 1 21	2	Banksia integrifolia
Ranunculus sessiliflorus		+		+1111+1111 111 1 1 1+ ++++1 ++ 1		Ranunculus sessiliflorus
Leucopogon parviflorus				+122+ + +12 1 +11 11	+1+	Leucopogon parviflorus
Rhagodia baccata				+11 1 11 + +1 + + +22 2 111 12+	112	Rhagodia baccata
Cotula australis	+			+1+ 1+1112++ +1 111 +++ + + +		Cotula australis
*Cerastium glomeratum	1 +	+		1111++++1+ 1 1+11+1 + ++++ + +1+1	+	*Cerastium glomeratum
Senecio spp.	+ +	+ 1		1++111 1 1+ +1 1 + +1 ++ +	+	Senecio spp.
Geranium potentilloides	+	++ +1		111+111 1 +1 + 11+11+111+ +1+ +++ +	1	Geranium potentilloides
Distichlis distichophylla				11 121 1 1 1 1 123 1 1+21		Distichlis distichophylla
Disphyma clavellatum				1 + 1 1+1+ 1 1 1111	1	Disphyma clavellatum
Samolus repens				1 + 1 1 1 1121+1 12 1 1+1		Samolus repens
Monotoca elliptica				11+ 2111211 123 + 11		Monotoca elliptica
Myoporum insulare				+ 1 + 2 1 ++ +11 1+11	+	Myoporum insulare
Cotula reptans				+ 1 1 1 +1 +1+ + 1 +2		Cotula reptans
Comesperma volubile	+ + ++	+ +	++ + +1	+ + + + + + 1 + +		Comesperma volubile
*Stellaria media		+		+ 1+ 1 1 +1 +++ + 1 +	+	*Stellaria media
*Holcus lanatus	+			+ ++ 1 +1 + + ++	+	*Holcus lanatus
Clematis microphylla				1111+ 1+ 1 + 1 1 ++ 1 11	11	Clematis microphylla
Leptospermum laevigatum				21 31 12 + +22 23	1 3	Leptospermum laevigatum
*Aira caryophyllea	++ + + + + +			1 1+11 1 + 1+ 1		*Aira caryophyllea
*Cirsium vulgare	+	++	+	1 +++ ++ ++ 1 +1+ ++1 1 + +	+	*Cirsium vulgare
Scirpus antarcticus	+ +			++++++++1 ++++++ 1++		Scirpus antarcticus
Imperata cylindrica	+2	1+ +	+ +	22 11+ + + 1 2 2 1++ +		Imperata cylindrica
Apium prostratum				+ 1 + + 1 ++ + 1 ++1	1++	Apium prostratum
Pelargonium australe		+		+ +	1+	Pelargonium australe
Calocephalus brownii				1	21	Calocephalus brownii
Spinifex hirsutus				+	+1	Spinifex hirsutus
*Ammophila arenaria				+	541	*Ammophila arenaria
Olearia axillaris					1+	Olearia axillaris
Actites megalocarpus				+1 1+	1 +	Actites megalocarpus
Elaeocarpus reticulatus		2 + +++	+			Elaeocarpus reticulatus
Goodenia ovata		12+ 21+				Goodenia ovata
Dianella caerulea		1+1 1 1	1 1 + + 1	+		Dianella caerulea
*Centaurium pulchellum			+	+ + + + ++		*Centaurium pulchellum
*Taraxacum officinale	+ + + 1			++ + 2+ + +		*Taraxacum officinale
Rumex brownii				+ + 2++ +		Rumex brownii
Rhagodia nutans				+ 1 + +1++		Rhagodia nutans
*Plantago coronopus	+			1+ 1+11		*Plantago coronopus

ALPINE WET HEATHLANDS GLC COMMUNITY 1 : SUB-COMMUNITY 1



CHARACTER SPECIES	% FREQ.	C/A
Baeckea gunniana	100	2
Empodisma minus	100	3
Epacris paludosa	100	2
Epacris breviflora	75	1
Hakea microcarpa	75	1
Poa australis spp. agg.	63	1
Asperula gunnii	63	1
Callistemon sieberi	63	2
Comesperma retusum	63	+
Epacris microphylla	63	1
Gonocarpus micranthus	63	1
Sphagnum spp.	63	2

NO. OF SITES : 8 (1.1% of total)

DISTRIBUTION : Restricted to the higher plateaux of the study area - Nunniong Plateau north of Ensay and Snowy Range north of Licola.

ENVIRONMENT : Exposed, damp depressions within high altitude plains.

ALTITUDE : Mean = 1332m, Highest = 1500m, Lowest = 1040m

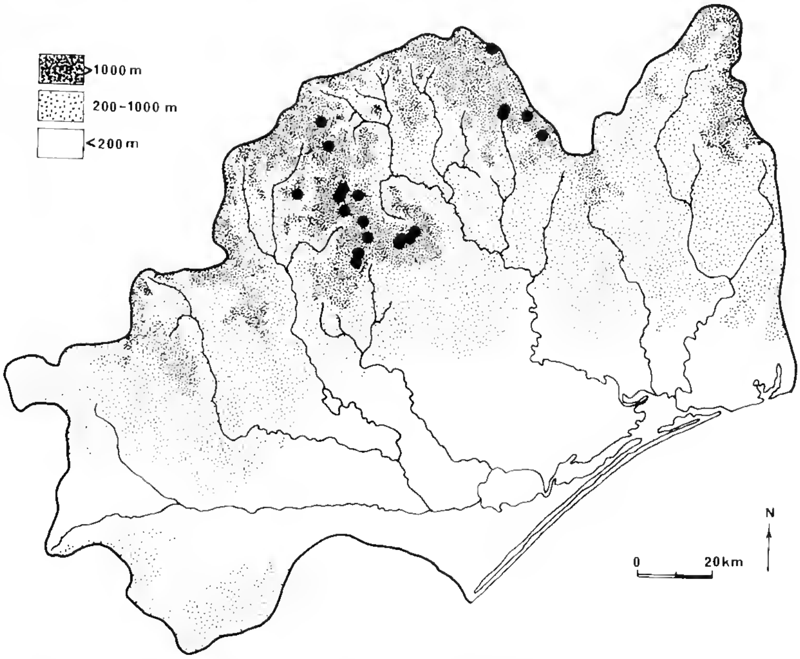
STRUCTURE : Closed heath

MEAN FLORISTIC RICHNESS : 32 species per site

MEAN WEED COMPOSITION : 2% of species, 1% of cover

NOTES : This sub-community is an alpine heath, containing several species which are characteristic of no other sub-community. This is the only sub-community in the alpine/subalpine range which is effectively devoid of a eucalypt canopy. Alpine heathlands are quite widespread in Victoria but the area they occupy is very small. Consequently the eight sites represented in this study although indicative of the area covered by this sub-community, are inadequate as descriptors of the variation in these complex communities.

ALPINE WET HEATHLANDS GLC COMMUNITY 1 : SUB-COMMUNITY 2



CHARACTER SPECIES	% FREQ.	C/A
Poa australis spp. agg.	100	1
Acaena anserinifolia	91	1
Eucalyptus pauciflora	83	1
*Hypochoeris radicata	83	+
Cotula filicula	83	+
Celmisia longifolia	78	+
Epacris paludosa	74	2
Baeckea gunniana	74	2
Stellaria pungens	74	1
Empodisma minus	74	1
Gonocarpus tetragynus	74	+
Stylidium graminifolium	74	1
Grevillea australis	70	1
Callistemon sieberi	70	1
Leucopogon suaveolens	65	1
Luzula campestris spp. agg.	65	+
*Trifolium repens	61	1
Carex appressa	61	2
Helichrysum scorpioides	61	1
Asperula gunnii	61	1
Tasmannia xerophila	61	1
Oxylobium alpestre	61	1
Deyeuxia quadriseta	61	+
Viola hederacea	61	+
Blechnum pennamarina	57	1
Oreomyrrhis eriopoda	57	1
Viola betonicifolia	57	+
Bossiaea foliosa	57	1
Hydrocotyle hirta	52	1
Carex breviculmis	52	+
Leptorhynchos squamatus	52	+
*Acetosella vulgaris	52	1

NO. OF SITES : 23 (3.3% of total)

DISTRIBUTION : Confined largely to the Snowy Range region but also occurring north of Mt. Baw Baw, near Matlock and near Mt. Tabletop & Phipps south of the Omeo to Hotham Heights road.

ENVIRONMENT : High altitude plains either fringing areas like sub-community 1.1 or in slightly more sheltered situations.

ALTITUDE : Mean = 1336m, Highest = 1630m, Lowest = 1020m

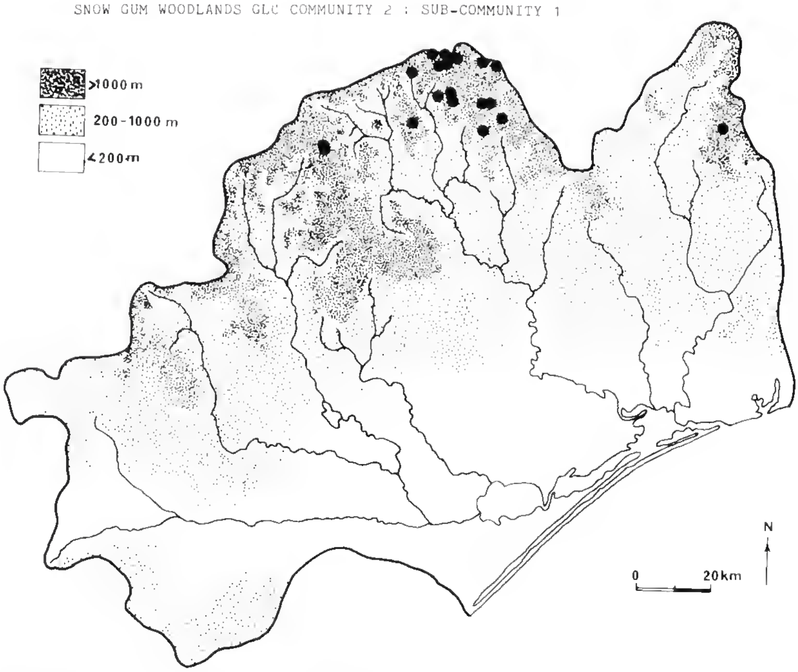
STRUCTURE : Low open-woodland to closed heath.

MEAN FLORISTIC RICHNESS : 52 species per site

MEAN WEED COMPOSITION : 5% of species, 4% of cover

NOTES : Although this sub-community is an alpine woodland, the shrubs and herbs it shares with sub-community 1.1 reflect its affinities with a damp alpine heath.

SNOW GUM WOODLANDS GLC COMMUNITY 2 : SUB-COMMUNITY 1



CHARACTER SPECIES	% FREQ.	C/A
Poa australis spp. agg.	96	2
Stellaria pungens	96	1
Eucalyptus pauciflora	92	2
Viola betonicifolia	88	1
Oreomyrrhis eriopoda	84	1
Oxylobium alpestre	80	2
*Acetosella vulgaris	80	1
*Hypochoeris radicata	80	1
Acaena anserinifolia	80	1
Geranium potentilloides	80	1
Leucopogon suaveolens	80	1
Cotula filicula	76	+
Tasmannia xerophila	72	1
Luzula campestris spp. agg.	72	+
Polystichum proliferum	72	1
Epilobium cinereum	68	1
Arthropodium milleflorum	60	+
Scleranthus biflorus	60	+
Senecio lautus	60	1
Celmisia longifolia	56	1
*Cerastium glomeratum	56	+
*Trifolium repens	56	1
Olearia phlogopappa	52	1
Craspedia glauca	52	1
Brachycome aculeata	52	1
Danthonia nudiflora	52	+
Prunella vulgaris	48	+
Asperula gunnii	48	1
Agropyron scabrum	48	+
Helichrysum scorpioides	48	1

NO. OF SITES : 25 (3.5% of total)

DISTRIBUTION : Occurs on higher ridges of the Great Dividing Range in the Mt. Hotham region, along the northern extremities of the Snowy Range, and with isolated occurrences on the Dargo High Plains and near Mt. Bindi, north of Ensay.

ENVIRONMENT : Ridgetops and nearby slopes, frequently with exposed basalt outcrops. Drier slopes than those supporting community 1.

ALTITUDE : Mean = 1476m, Highest = 1703m, Lowest = 1300m

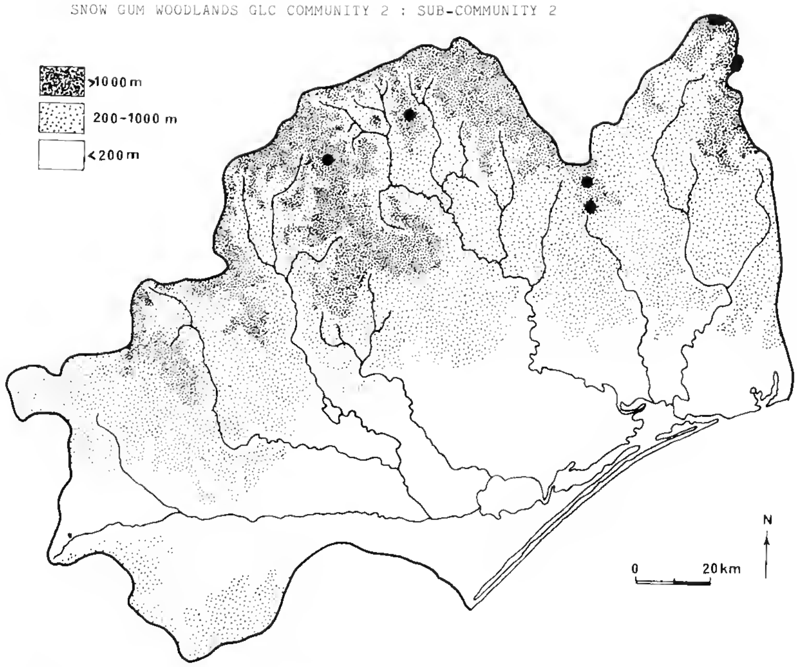
STRUCTURE : Low woodland

MEAN FLORISTIC RICHNESS : 42 species per site

MEAN WEED COMPOSITION : 9% of species, 8% of cover

NOTES : This sub-community embraces what is commonly known as Snow Gum Woodland. It contains a wide variety of low perennial herbs and grasses forming a dense ground layer. The shrub layer is usually less than 1.5m and comparatively sparse.

SNOW GUM WOODLANDS GLC COMMUNITY 2 : SUB-COMMUNITY 2



CHARACTER SPECIES	% FREQ.	C/A
Acaena anserinifolia	88	1
Ranunculus graniticola	88	+
Stellaria pungens	88	+
Poa australis spp. agg.	88	2
Luzula campestris spp. agg.	75	1
Geranium potentilloides	75	1
Leucopogon suaveolens	75	1
Oreomyrrhis eriopoda	75	1
Asperula scoparia	63	+
Olearia erubescens	63	1
Celmisia longifolia	63	1
Eucalyptus pauciflora	63	2

NO. OF SITES : 8 (1.1% of total)

DISTRIBUTION : Scattered along the Great Dividing Range from the Snowy Range to the Bowen Mountains.

ENVIRONMENT : Well drained slopes grading to moister flats or depressions.

ALTITUDE : Mean = 1337m, Highest = 1600m, Lowest = 980m.

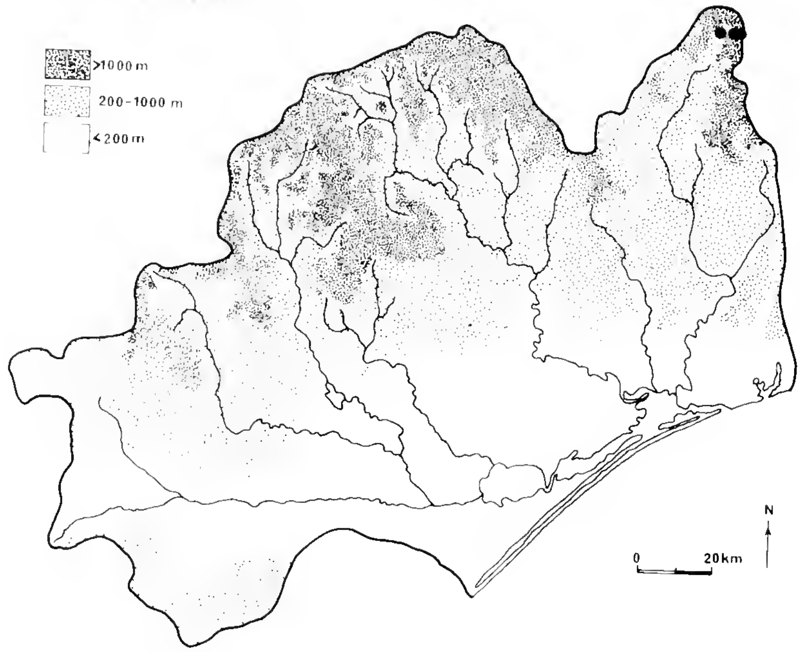
STRUCTURE : Low woodland

MEAN FLORISTIC RICHNESS : 33 species per site

MEAN WEED COMPOSITION : 4% of species, 3% of cover

NOTES : A species poor version of sub-community 2.1 with some affinities for sub-community 1.2 (e.g. the presence of wetland species such as *Leptospermum grandifolium, Carex appressa* and *Eucalyptus stellulata* in some of the sites of this sub-community.

MONTANE FORE[illegible]OMMUNITY 3 : SUB-COMMUNITY 1



CHARACTER SPECIES	% FREQ.	C/A
Acaena anserinifolia	100	+
Acrotriche serrulata	100	1
Craspedia glauca	100	+
Eucalyptus dives	100	1
Eucalyptus rubida	100	1
Gonocarpus tetragynus.	100	+
Helichrysum scorpioides	100	+
Hibbertia obtusifolia	100	+
Luzula campestris spp. agg.	100	1
Olearia erubescens	100	+
Platylobium formosum	100	1
Pultenaea juniperina	100	3
Ranunculus graniticola	100	1
Poa australis spp. agg.	100	2
Epacris impressa	67	+
Lomandra longifolia	67	1
Danthonia spp.	67	1
Deyeuxia spp.	67	1
Epilobium spp.	67	1
Asperula scoparia	67	1
Brachycome decipiens	67	1
Carex breviculmis	67	+
Cassinia aculeata	67	1
Daviesia latifolia	67	1
Dianella revoluta	67	+
Eucalyptus pauciflora	67	1
Eucalyptus radiata	67	1
Exocarpus strictus	67	1
Geranium potentilloides	67	+
Hydrocotyle hirta	67	+
Hypericum gramineum	67	+
*Hypochoeris radicata	67	1
Persoonia chamaepeuce	67	1

NO. OF SITES : 3 (0.4% of total)

DISTRIBUTION : Confined to the north-east of the study area in the Nunniong Plateau area.

ENVIRONMENT : Well drained slopes of northerly to northwesterly aspect.

ALTITUDE : Mean = 1156m, Highest = 1270m, Lowest = 1000m.

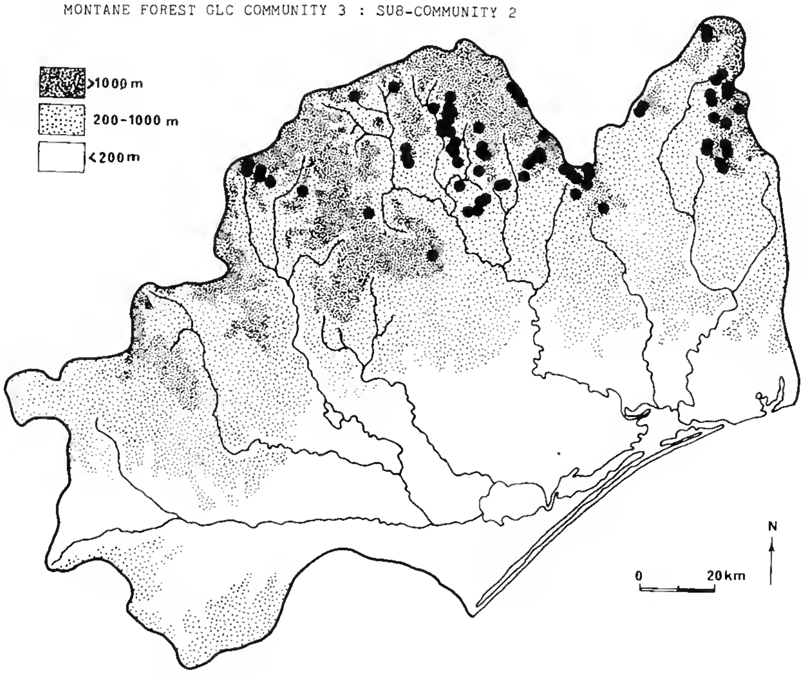
STRUCTURE : Low woodland

MEAN FLORISTIC RICHNESS : 33 species per site

MEAN WEED COMPOSITION : 3% of species, 2% of cover

NOTES : A very species poor version of sub-community 3.2

MONTANE FOREST GLC COMMUNITY 3 : SUB-COMMUNITY 2



CHARACTER SPECIES	% FREQ.	C/A
Poa australis spp. agg.	94	2
Acacia dealbata	86	1
Dianella tasmanica	82	1
Eucalyptus rubida	81	1
Gonocarpus tetragynus	81	1
Acaena anserinifolia	77	1
Coprosma hirtella	77	1
Stellaria pungens	76	1
Stylidium graminifolium	76	1
Lomandra longifolia	71	1
Viola hederacea	68	1
Polyscias sambucifolius	63	1
Pteridium esculentum	60	1
Polystichum proliferum	59	1
Hydrocotyle hirta	58	1
Cassinia aculeata	56	1
Eucalyptus dives	56	1
Lagenifera stipitata	55	+
Daviesia ulicifolia	54	1
Geranium potentilloides	54	+
Eucalyptus pauciflora	54	2
Leucopogon suaveolens	53	1
Luzula campestris spp. agg.	53	+
Asperula scoparia	53	1
Acacia obliquinervia	51	1
Cotula filicula	51	+
Olearia erubescens	51	1
Clematis aristata	50	+
Platylobium formosum	49	1
Helichrysum scorpioides	47	1
Senecio quadridentatus	42	+
Olearia phlogopappa	38	1
Oreomyrrhis eriopoda	38	1
Arthropodium milleflorum	38	+
Eucalyptus delegatensis	37	2
*Hypochoeris radicata	36	+
Olearia myrsinoides	36	1

NO. OF SITES : 80 (11% of total)

DISTRIBUTION : Frequent on sheltered slopes forming the catchments of the Macalister and Wonnangatta Rivers and up to the Great Dividing Range from Mt. Hotham to the Nunniong Plateau.

ENVIRONMENT : Moist and sheltered subalpine slopes.

ALTITUDE : Mean = 1187m, Highest = 1440m, Lowest = 860m.

STRUCTURE : Open to Tall open-forest

MEAN FLORISTIC RICHNESS : 37 species per site

MEAN WEED COMPOSITION : 2% of species, 1% of cover

NOTES : The structural variation in the sub-community is related to the presence or absence of the four major species of *Eucalyptus; E. pauciflora, E. rubida, E. dives* and *E. delegatensis*. Where *E. delegatensis* occurs in significant quantities the forest is of considerable value for timber production and is usually of the structural type Tall open-forest. Where the other species dominate the structural type is open-forest. Despite this structural variation there is a strong floristic uniformity throughout sub-community 3.2

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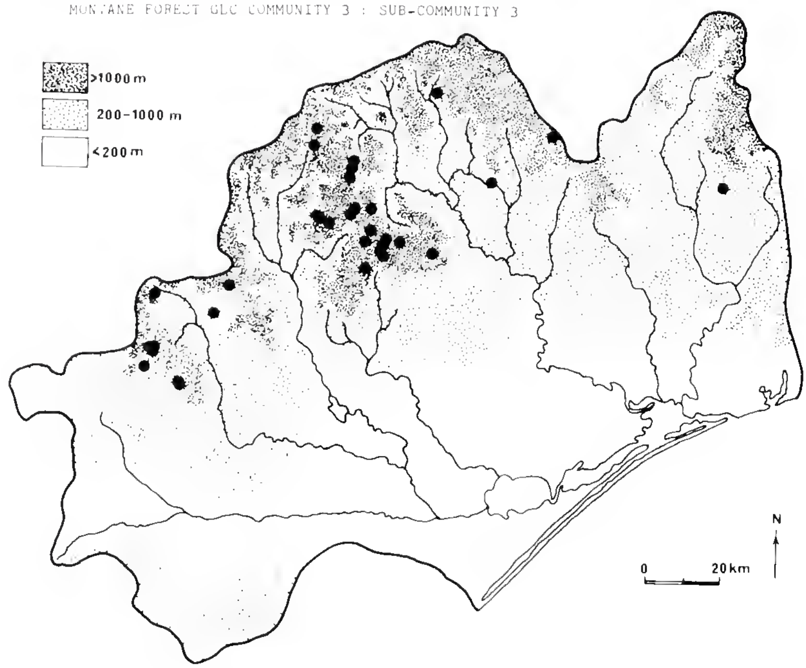
MONTANE FOREST GLC COMMUNITY 3 : SUB-COMMUNITY 3



CHARACTER SPECIES	% FREQ.	C/A
Poa australis spp. agg.	97	1
Dianella tasmanica	91	1
Acaena anserinifolia	82	1
Polyscias sambucifolius	79	1
Coprosma hirtella	79	1
Stellaria pungens	76	1
Helichrysum scorpioides	74	1
Cotula filicula	74	1
Polystichum proliferum	74	1
Stylidium graminifolium	74	1
Olearia phlogopappa	74	1
Oreomyrrhis eriopoda	71	1
Gonocarpus tetragynus	68	+
Viola hederacea	68	1
Acacia obliquinervia	65	1
Lagenifera stipitata	62	1
Luzula campestris spp. agg.	62	+
Eucalyptus delegatensis	59	2
Veronica derwentia	59	1
*Hypochoeris radicata	59	+
Cassinia aculeata	59	1
Arthropodium milleflorum	56	+
Ranunculus plebeius	56	+
Hydrocotyle hirta	56	1
Acacia dealbata	56	1
Olearia erubescens	53	1
Olearia megalophylla	53	1
Geranium potentilloides	53	1
Brachycome aculeata	50	1
Eucalyptus rubida	50	1
Daviesia ulicifolia	47	1
Senecio linearifolius	47	1
Leucopogon gelidus	47	1

NO. OF SITES : 34 (4.7% of total)

DISTRIBUTION : Moderately widespread on the upper, well-watered slopes of the Snowy Range, north of Mt.Tamboritha, eastward to the Mt.Wellington region and scattered between the Aberfeldy and Mt.Baw Baw regions.

ENVIRONMENT : Moist and sheltered subalpine slopes.

ALTITUDE : Mean = 1249m, Highest = 1580m, Lowest = 800m.

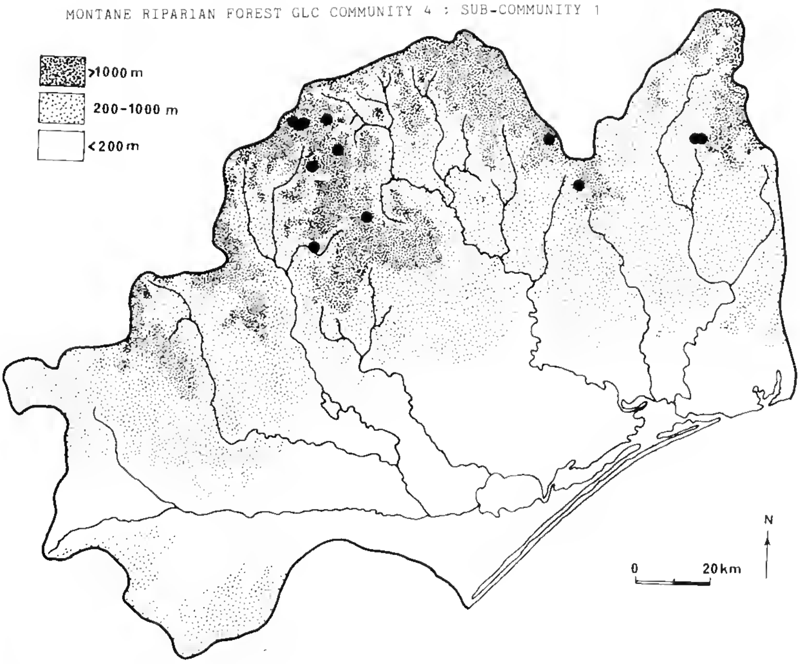
STRUCTURE : Open to Tall open-forest

MEAN FLORISTIC RICHNESS : 42 species per site

MEAN WEED COMPOSITION : 4% of species, 3% of cover

NOTES : This sub-community is floristically very similar to sub-community 3.2. Its distribution in the higher rainfall areas to the west of the study area and its proximity to gullies means that some wetland species (e.g. *Leptospermum grandifolium* and *Carex appressa*) are common and species characteristic of drier country (e.g. *E. dives* and *Platylobium formosum*) are absent. Sub-community 3.3 is more often dominated by *E. delegatensis* than is sub-community 3.2

MONTANE RIPARIAN FOREST GLC COMMUNITY 4 : SUB-COMMUNITY 1



CHARACTER SPECIES	% FREQ.	C/A
Polystichum proliferum	100	2
Acaena anserinifolia	91	1
Poa australis spp. agg.	91	1
Blechnum fluviatile	82	1
Eucalyptus delegatensis	82	1
Australina muelleri	82	1
Geranium potentilloides	82	1
Carex appressa	73	1
Leptospermum grandifolium	73	2
Rubus parvifolius	73	1
Acacia dealbata	73	1
Cassinia aculeata	73	1
Dicksonia antarctica	73	2
Senecio linearifolius	73	1
Polyscias sambucifolius	73	+
Urtica incisa	73	1
Cotula filicula	64	+
Hydrocotyle hirta	64	1
Stellaria flaccida	64	1
Tasmannia lanceolata	64	1
Gnaphalium japonicum	64	+
Olearia phlogopappa	64	1
*Hypochoeris radicata	55	+
Lagenifera stipitata	55	+
Coprosma hirtella	55	1
Daviesia latifolia	55	1
Hypolepis rugosula	55	+

NO. OF SITES : 12 (1.6% of total)

DISTRIBUTION : Most common around the Snowy Range but is also scattered near Mts. Birregun and Nugong.

ENVIRONMENT : Deep gullies and watercourses contained within tall, sheltered, montane to subalpine forests.

ALTITUDE : Mean = 1121m, Highest = 1500m, Lowest = 820m.

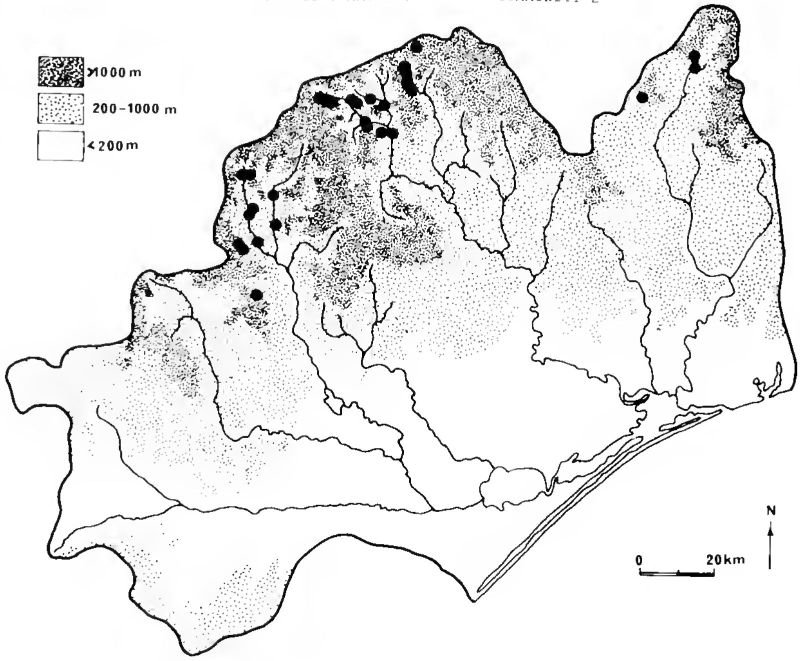
STRUCTURE : Tall open-forest

MEAN FLORISTIC RICHNESS : 42 species per site

MEAN WEED COMPOSITION : 5% of species, 3% of cover

NOTES : This sub-community includes the subalpine parallel of the well-known fern gully of lower wet sclerophyll forests. Many species are common to both these vegetation types but species such as *Leptospermum grandifolium* and *Eucalyptus delegatensis* identify sub-community 4.1 as one restricted to higher altitudes.

MONTANE RIPARIAN FOREST GLC COMMUNITY 4 : SUB-COMMUNITY 2



CHARACTER SPECIES	% FREQ.	C/A
Rubus parvifolius	93	1
Pteridium esculentum	90	1
Acacia dealbata	90	1
Geranium potentilloides	90	1
Coprosma quadrifida	86	1
Eucalyptus radiata	86	1
Acacia melanoxylon	86	1
Viola hederacea	86	1
Acaena anserinifolia	83	1
Clematis aristata	83	1
Carex appressa	83	1
Cassinia aculeata	76	1
Asperula scoparia	76	1
Poa australis spp. agg.	76	1
Stellaria pungens	76	+
Gnaphalium japonicum	72	+
Blechnum nudum	72	1
Hydrocotyle hirta	72	1
Pomaderris aspera	69	1
Polystichum proliferum	69	1
Prunella vulgaris	66	1
Eucalyptus viminalis	66	1
Cotula filicula	62	+
*Hypochoeris radicata	59	1
Lagenifera stipitata	59	1
Polyscias sambucifolius	59	1
Dichondra repens	52	1
Epilobium cinereum	52	+
Leptospermum grandifolium	52	1
Dianella tasmanica	48	1
Echinopogon ovatus	48	1
Stellaria flaccida	48	+

NO. OF SITES : 29 (4.0% of total)

DISTRIBUTION : Localized within an area including creeksides and headwaters of the Wonnongatta, Wongungarra, Macalister and Humffray Rivers.

ENVIRONMENT : High altitude creeksides, often containing large granite boulders but invariably with a buildup of alluvial soils.

ALTITUDE : Mean = 746m, Highest = 1500m, Lowest = 300m.

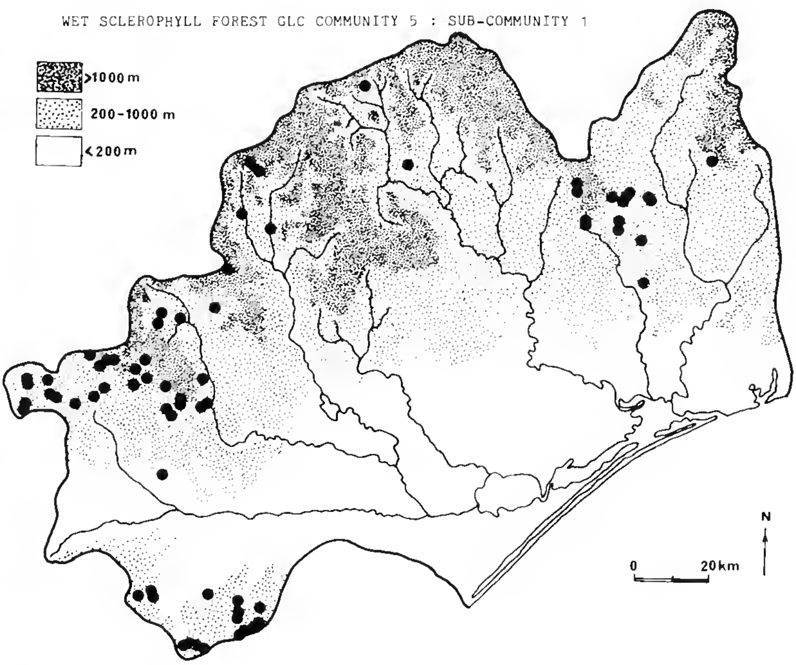
STRUCTURE : Open to Tall open-forest

MEAN FLORISTIC RICHNESS : 52 species per site

MEAN WEED COMPOSITION : 7% of species,6% of cover

NOTES : Structurally, this sub-community is quite typical of both highland and lowland riparian communities. It is characterised by a tall canopy and a dense shrub layer, overlying a ground layer containing a variety of ferns and sedges. Many species of this sub-community are common to riverside sites throughout the State (e.g. *Eucalyptus viminalis, E. radiata, Acacia melanoxylon, Rubus parvifolius, Pomaderris aspera)* but certain species identify this community as being montane (e.g. *Leptospermum grandifolium).*

WET SCLEROPHYLL FOREST GLC COMMUNITY 5 : SUB-COMMUNITY 1



CHARACTER SPECIES	% FREQ.	C/A
Polystichum proliferum	85	1
Clematis aristata	83	1
Acacia dealbata	82	1
Hydrocotyle hirta	81	1
Pteridium esculentum	79	1
Viola hederacea	78	1
Acaena anserinifolia	76	1
Dicksonia antarctica	75	1
Cassinia aculeata	75	1
Geranium potentilloides	71	1
Senecio linearifolius	71	1
Coprosma quadrifida	69	1
Alsophila australis	65	1
Tetrarrhena juncea	64	1
Olearia phlogopappa	61	1
Pomaderris aspera	61	1
Eucalyptus regnans	58	2
Prostanthera lasianthos	58	1
Histiopteris incisa	57	+
Australina muelleri	54	1
Olearia lirata	54	1
Olearia argophylla	53	1
Stellaria flaccida	53	1
Polyscias sambucifolius	50	1
*Hypochoeris radicata	49	+
Acacia melanoxylon	46	1
Sambucus gaudichaudiana	44	1
*Rubus fruticosus spp. agg.	44	1
Oxalis corniculata	42	+
Bedfordia arborescens	42	1
Blechnum nudum	40	1
Urtica incisa	38	1
Dianella tasmanica	36	+
Blecnhum wattsii	36	1

NO. OF SITES : 73 (10.1% of total)

DISTRIBUTION : A widespread community occurring as far east as the upper Tambo River catchment (Mt.Baldhead/Ensay region), less commonly near the Wongungarra and Macalister Rivers but frequent in the Central Gippsland highlands, Noojee/Mt.Baw Baw area and the Strzlecki Ranges to the South.

ENVIRONMENT : Well watered montane sites to about 1200m altitude.

ALTITUDE : Mean = 645m, Highest = 1300m, Lowest = 130m.

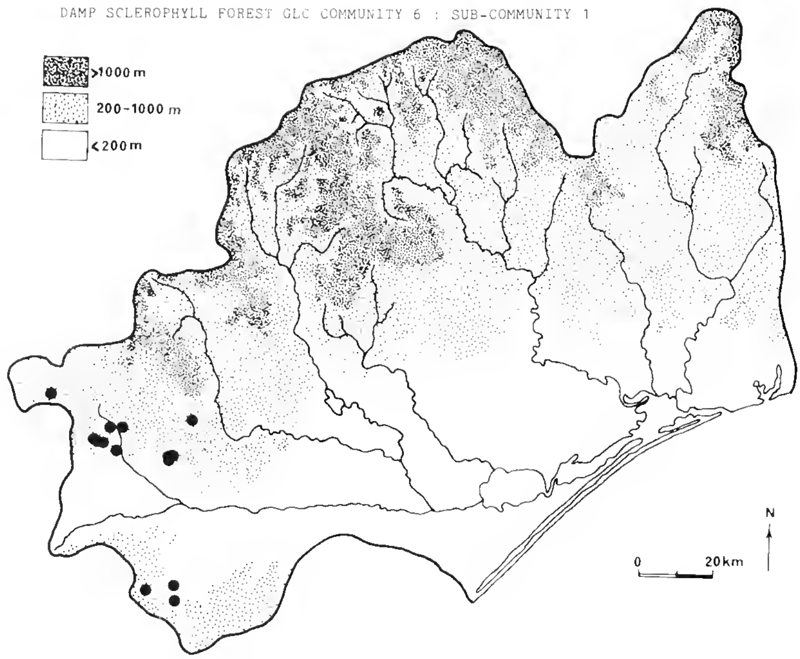
STRUCTURE : Tall open-forest

MEAN FLORISTIC RICHNESS : 37 species per site

MEAN WEED COMPOSITION : 7% of species,5% of cover

NOTES : This selection of sites contains virtually all of the Mountain Ash forests encountered in this study. This species (*Eucalyptus regnans*) is the tallest hardwood tree in the world and is keenly sought for its timber. The "shrub layer", including *Acacia spp.*,of such tall forests frequently attains heights of 30m, and may be virtually unstratified to about 10m. Low light conditions below this level, along with deep leaf litter, usually mean a low species richness for the ground layer.

DAMP SCLEROPHYLL FOREST GLC COMMUNITY 6 : SUB-COMMUNITY 1



CHARACTER SPECIES	% FREQ.	C/A
Tetrarrhena juncea	100	2
Gonocarpus tetragynus	93	1
Leptospermum juniperinum	93	1
Pultenaea gunnii	87	1
Acacia mucronata	87	1
Eucalyptus obliqua	87	1
Gahnia radula	80	2
Epacris impressa	80	1
Pteridium esculentum	80	1
Viola hederacea	80	1
Lomandra filiformis	73	1
*Hypochoeris radicata	73	+
Amperea xiphoclada	67	1
Cassinia aculeata	67	+
Eucalyptus radiata	67	1
Lomandra longifolia	67	+
Poa australis spp. agg.	67	1
Goodenia ovata	60	1
Burchardia umbellata	60	1
Drosera auriculata	60	1
Olearia lirata	60	+
Xanthorrhoea minor	60	1
Eucalyptus consideniana	53	2

NO. OF SITES : 15 (2.0% of total)

DISTRIBUTION : Occurring in the south-west of the study area around Neerim South, Tanjil South and Boolarra.

ENVIRONMENT : Dry slopes and gullies

ALTITUDE : Mean = 250m, Highest = 400m, Lowest = 160m.

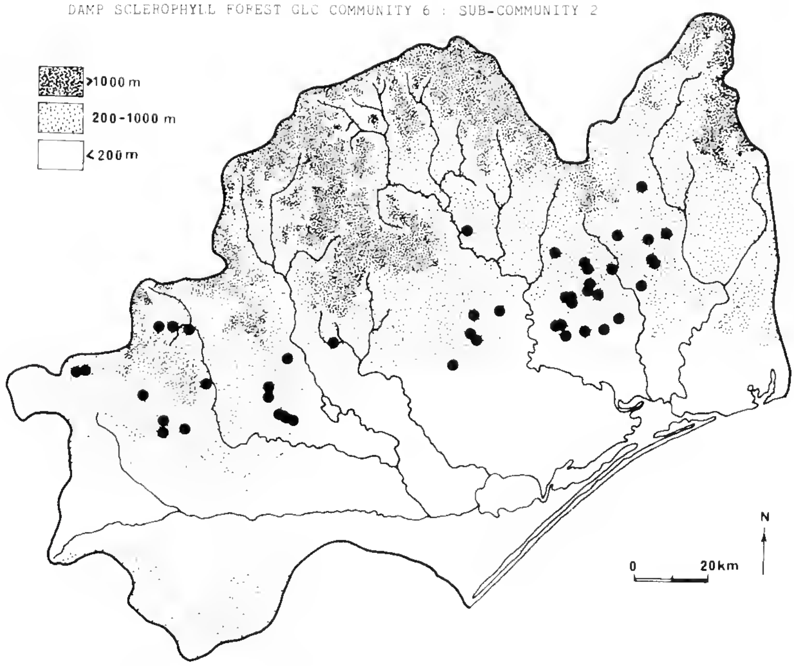
STRUCTURE : Open forest or Woodland

MEAN FLORISTIC RICHNESS : 40 species per site

MEAN WEED COMPOSITION : 3% of species, 1% of cover

NOTES : This sub-community occurs commonly on the lower, more exposed sides of hills which also support sub-community 6.2 and 6.3. It is the lowest altitude sub-community of Community 6. The understorey supports species usually regarded as characteristic of dry areas or heathlands (e.g. *Amperea xiphoclada, Epacris impressa, Xanthorrhoea minor*) as well as those characteristic of fire regeneration (e.g. *Goodenia* sp., *Cassinia* spp. and *Leptospermum* sp.). This is the only vegetation of the study area in which *E. consideniana* is a character species.

DAMP SCLEROPHYLL FOREST GLC COMMUNITY 6 : SUB-COMMUNITY 2



CHARACTER SPECIES	% FREQ.	C/A
Pteridium esculentum	94	1
Viola hederacea	91	1
Acacia dealbata	85	1
Clematis aristata	81	1
Eucalyptus cypellocarpa	74	1
Geranium potentilloides	74	1
Poa australis spp. agg.	74	1
Dianella tasmanica	70	1
Gonocarpus teucrioides	62	1
Eucalyptus obliqua	62	1
Cassinia aculeata	62	1
Lagenifera stipitata	60	+
Lomandra longifolia	58	1
Cassinia longifolia	57	1
*Hypochoeris radicata	57	+
Oxalis corniculata	57	+
Coprosma quadrifida	57	1
Tetrarrhena juncea	55	1
Pomaderris aspera	55	1
Goodenia ovata	51	1
Acaena anserinifolia	51	1
Billardiera scandens	47	+
Epacris impressa	47	1
Alsophila australis	47	1
Hydrocotyle hirta	47	1
Microlaena stipoides	43	1
Senecio quadridentatus	42	+
Olearia lirata	42	1
Culcita dubia	40	1
Gonocarpus tetragynus	40	1
Gnaphalium japonicum	38	+
Senecio linearifolius	38	1
Pimelea axiflora	38	1
Blechnum cartilagineum	36	1
Eucalyptus radiata	36	1
Galium gaudichaudii	36	+

NO. OF SITES : 53 (7.3% of total)

DISTRIBUTION : Occurring over most of the intermediate altitude range of the study area from Noojee to Ensay.

ENVIRONMENT : Wet, foothill slopes usually sheltered from direct northerly exposure.

ALTITUDE : Mean = 436m, Highest = 900m, Lowest = 100m.

STRUCTURE : Open to Tall open-forest

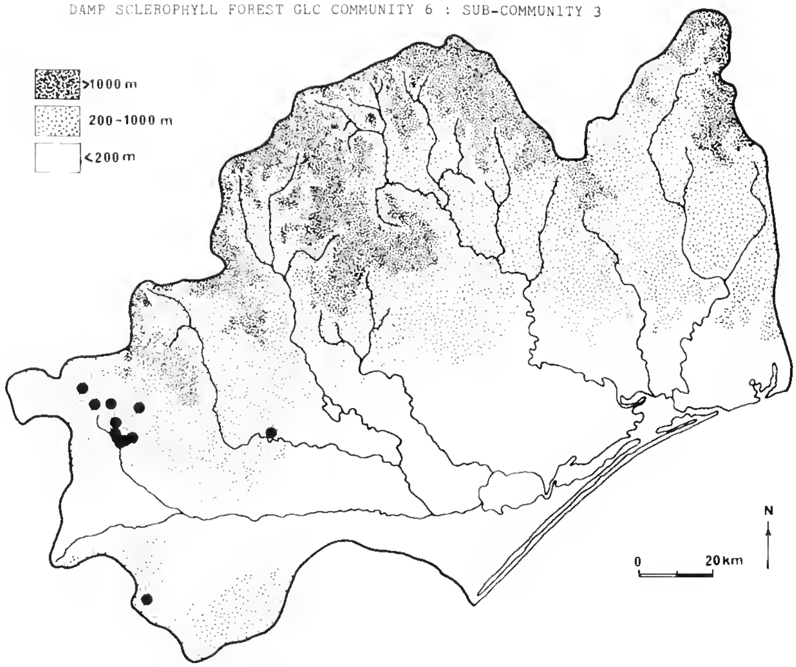
MEAN FLORISTIC RICHNESS : 42 species per site

MEAN WEED COMPOSITION : 3% of species, 2% of cover

NOTES : The frequency of *Pteridium esculentum* indicates significant disturbance (particularly fire induced) to this common vegetation type of the foothills. *E. cypellocarpa* and *E. obliqua*, which dominate the upper stratum, and the understorey of sclerophyllous shrubs, herbs and grasses are all widespread. This sub-community represents a transition between wet and dry sclerophyll vegetation types.

A riparian, wetter variant of this sub-community contains *Prostanthera lasianthos* and *E. viminalis*.

DAMP SCLEROPHYLL FOREST GLC COMMUNITY 6 : SUB-COMMUNITY 3



CHARACTER SPECIES	% FREQ.	C/A
Cassinia aculeata	100	1
Coprosma quadrifida	100	1
Eucalyptus cypellocarpa	100	1
Eucalyptus obliqua	100	1
Gonocarpus teucrioides	100	1
Olearia lirata	100	1
Pteridium esculentum	100	1
Viola hederacea	100	1
Acacia mucronata	92	1
Clematis aristata	92	1
Tetrarrhena juncea	92	2
Alsophila australis	85	1
*Hypochoeris radicata	85	+
Eucalyptus radiata	85	1
Goodenia ovata	85	1
Geranium potentilloides	77	1
Pomaderris aspera	77	1
Pultenaea juniperina	77	1
Acacia verticillata	77	1
Blechnum cartilagineum	77	1
Culcita dubia	77	1
Acacia dealbata	69	1
Hydrocotyle hirta	69	+
Lepidosperma elatius	69	1
Pimelia axiflora	69	1
*Rubus fruticosus spp. agg.	69	+
Oxalis corniculata	62	+
Polyscias sambucifolius	62	1
Platylobium formosum	62	2
Blechnum nudum	62	1
Prunella vulgaris	54	+
Rubus parvifolius	54	1
Gnaphalium japonicum	54	+
Senecio quadridentatus	54	+
Tetratheca ciliata	54	1

NO. OF SITES : 13 (1.8% of total)

DISTRIBUTION : Common forests of the Noojee, Tanjil Bren and Loch Valley areas with a single record to the south in the Strzlecki Ranges.

ENVIRONMENT : Contained within gullies of montane, open-forests but not necessarily adjacent to permanent waterways.

ALTITUDE : Mean = 300m, Highest = 500m, Lowest = 180m.

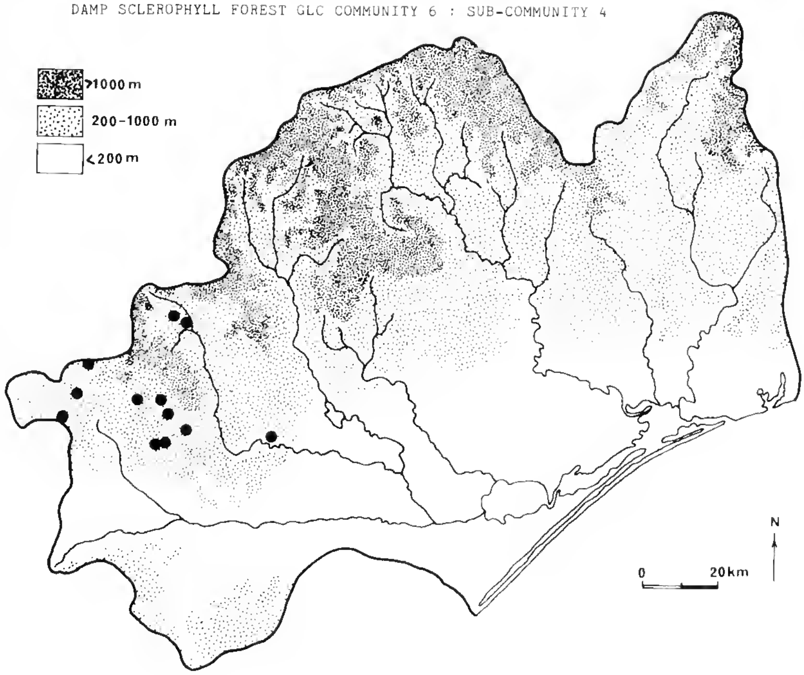
STRUCTURE : Open-forest

MEAN FLORISTIC RICHNESS : 51 species per site

MEAN WEED COMPOSITION : 6% of species,3% of cover

NOTES : A floristically rich sub-community, the canopy consisting of several species (e.g. *E.cypellocarpa, E. obliqua, E. radiata, Acacia dealbata)* and the lower strata containing a diverse assortment of damp forest species (e.g. *Platylobium formosum, Tetratheca ciliata, Acacia mucronata, A. verticillata, Pimelia axiflora)*. Disturbance within sub-community 6.3 if low. This is reflected in the fairly high species richness, particularly when compared with sub-community 6.4 (a disturbed, lower diversity subset of this sub-community).

DAMP SCLEROPHYLL FOREST GLC COMMUNITY 6 : SUB-COMMUNITY 4



CHARACTER SPECIES	% FREQ.	C/A
Pteridium esculentum	100	1
Tetrarrhena juncea	100	2
Eucalyptus obliqua	92	1
Viola hederacea	92	+
Eucalyptus cypellocarpa	83	1
Acacia mucronata	75	2
Eucalyptus sieberi	75	2
Goodenia ovata	75	1
Platylobium formosum	75	3
Eucalyptus radiata	67	1
Gonocarpus teucrioides	67	1
Cassinia aculeata	67	1
Tetratheca ciliata	58	1
Pomaderris aspera	58	1
Bedfordia arborescens	58	+
Pultenaea juniperina	58	1

NO. OF SITES : 12 (1.7% of total)

DISTRIBUTION : Scattered distribution between the Noojee and Aberfeldy areas.

ENVIRONMENT : Well-watered slopes of upland areas in and around the Baw Baw ranges. The sites, however, are not those which retain moisture for long periods. Soils are frequently gravelly clays.

ALTITUDE : Mean = 547m, Highest = 950m, Lowest = 200m.

STRUCTURE : Open-forest

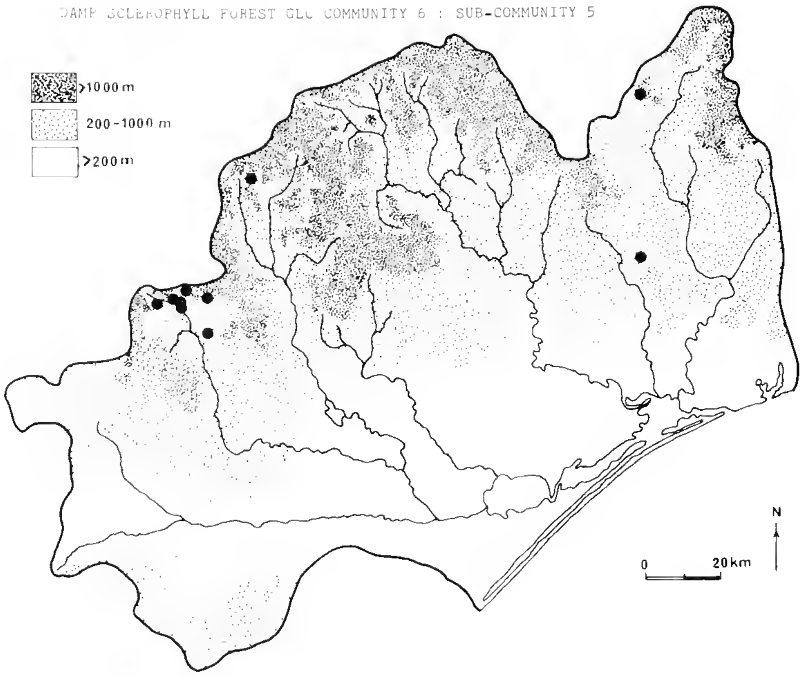
MEAN FLORISTIC RICHNESS : 30 species per site

MEAN WEED COMPOSITION : 0% of species, 0% of cover

NOTES : A mixed species forest which is a lower diversity version of sub-community 6.3. Each of the most common eucalypts are of commercial value and are or have been harvested for building timber (the range of this sub-community is contained within a long-active milling and forest management area).

A result of this activity is the high proportion and abundance of species which although native, are indicative of disturbances within the forest (particularly fuel reduction burning). Species such as *Pteridium esculentum, Tetrarrhena juncea, Acacia mucronata, Platylobium formosum, Pultenaea juniperina* and *Eucalyptus sieberi* are becoming increasingly common due to present forest management practices. Another consequence of these activities is the very low floristic richness and almost complete absence of introduced species.

DAMP SCLEROPHYLL FOREST GLC COMMUNITY 6 : SUB-COMMUNITY 5



CHARACTER SPECIES	% FREQ.	C/A
Daviesia ulicifolia	100	1
Dianella tasmanica	100	1
Pteridium esculentum	100	1
Acacia dealbata	90	1
Cassinia aculeata	90	1
Eucalyptus radiata	90	1
Gonocarpus tetragynus	90	1
Poa australis spp. agg.	90	2
Senecio quadridentatus	90	+
Stylidium graminifolium	80	1
Viola hederacea	80	1
Lomandra longifolia	80	1
Luzula campestris spp. agg.	80	+
Gnaphalium japonicum	70	+
Eucalyptus cypellocarpa	70	1
Geranium potentilloides	70	+
Stellaria pungens	70	1
Hydrocotyle hirta	60	1
Acacia mucronata	60	2
Coprosma hirtella	60	1
Eucalyptus dives	60	1
*Hypochoeris radicata	60	+
Tetrarrhena juncea	60	1
Acaena anserinifolia	60	1
Deyeuxia rodwayi	60	1
Polystichum proliferum	60	1
Senecio linearifolius	60	1
Polyscias sambucifolius	60	1

NO. OF SITES : 10 (1.4% of total)

DISTRIBUTION : Slopes of the Great Dividing Range in the region of Aberfeldy and Matlock with an isolated occurrence on the Bowen Range near Ensay.

ENVIRONMENT : High-altitude, well-drained hillside.

ALTITUDE : Mean = 875m, Highest = 1120m, Lowest = 650m.

STRUCTURE : Open-forest

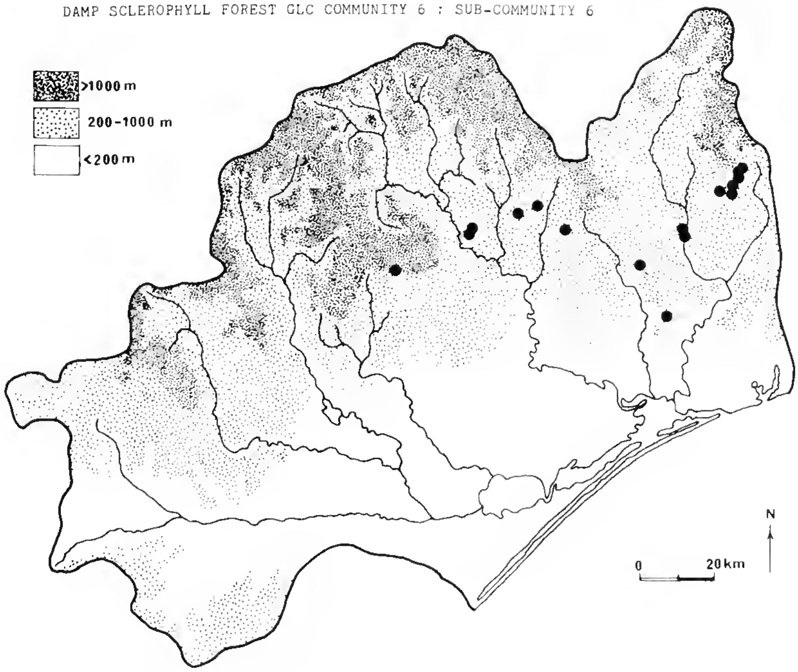
MEAN FLORISTIC RICHNESS : 45 species per site

MEAN WEED COMPOSITION : 3% of species, 2% of cover

NOTES : This sub-community retains a number of species common to the sub-communities 6.3 and 6.4 (e.g. *Eucalyptus cypellocarpa, Polyscias sambucifolia, Polystichum proliferum*) but includes several other species which indicate the well-drained nature of the soils within the region (e.g. *E. dives, Lomandra longifolia, Daviesia ulicifolia*).

The absence of significant quantities of merchantable timber within sub-community 6.5 virtually precludes the incidence of disturbance to the forest as a result of timber harvesting. However, fire appears to have had a modifying influence in promoting certain (native) species to proportions above those expected in an undisturbed forest. (e.g. *Pteridium esculentum, Acacia mucronata, Tetrarrhena juncea*).

DAMP SCLEROPHYLL FOREST GLC COMMUNITY 6 : SUB-COMMUNITY 6



CHARACTER SPECIES	% FREQ.	C/A
Poa australis spp. agg.	83	1
Pteridium esculentum	83	1
Eucalyptus cypellocarpa	78	1
Lomandra longifolia	78	1
Gonocarpus tetragynus	78	1
Hydrocotyle hirta	72	+
Poranthera microphylla	72	+
Galium gaudichaudii	72	+
Hibbertia obtusifolia	72	1
Viola hederacea	72	1
*Hypochoeris radicata	67	+
Senecio quadridentatus	67	+
Eucalyptus globoidea	67	1
Geranium potentilloides	61	+
Acacia dealbata	61	1
Olearia lirata	61	1
Acaena anserinifolia	56	1
Cassinia longifolia	56	1
Clematis aristata	56	+
Eucalyptus obliqua	56	1

NO. OF SITES : 15 (2.0% of total)

DISTRIBUTION : Scattered around Mt. Wellington, Mt. Thomson and Mt. Steve near the upper reaches of the Dargo and Wentworth Rivers, and also east on Mt.Sugarloaf, Mt.Little Dick and south east of Mt. Nugong near Ensay.

ENVIRONMENT : Intermediate altitudes on sheltered slopes, but not extending to gullies.

ALTITUDE : Mean = 664m, Highest = 980m, Lowest = 280m.

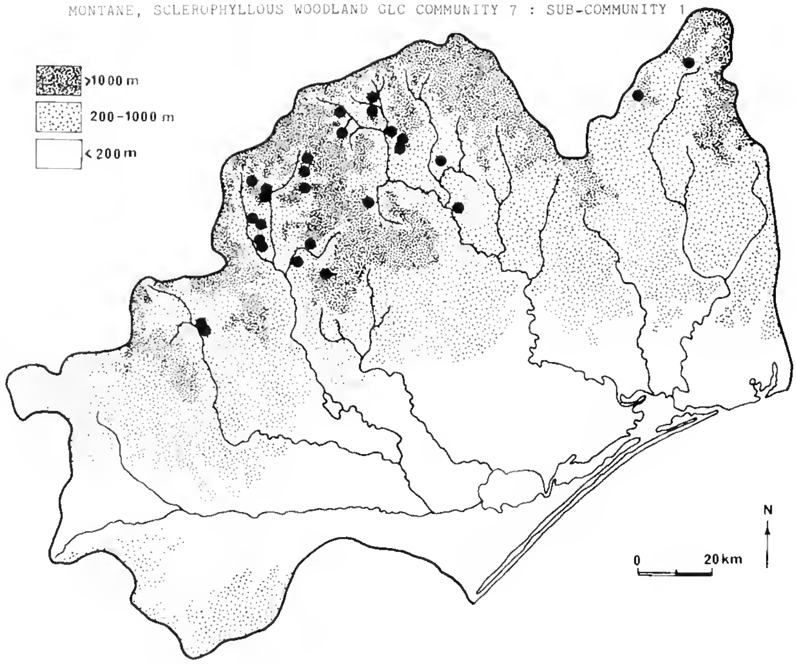
STRUCTURE : Open to Tall open-forest

MEAN FLORISTIC RICHNESS : 38 species per site

MEAN WEED COMPOSITION : 3% of species,2% of cover

NOTES : A rather poorly defined sub-community existing as a congregation of several species which although mainly native are indicative of fire disturbance.

MONTANE, SCLEROPHYLLOUS WOODLAND GLC COMMUNITY 7 : SUB-COMMUNITY 1



CHARACTER SPECIES	% FREQ.	C/A
Poa australis spp. agg.	100	1
Lomandra longifolia	93	1
Eucalyptus dives	93	1
Dianella revoluta	86	1
Hibbertia obtusifolia	86	1
Platylobium formosum	82	1
Gonocarpus tetragynus	82	1
Eucalyptus mannifera	79	1
Exocarpus strictus	75	+
Persoonia confertiflora	75	+
Tetratheca ciliata	71	1
Pimelia linifolia	68	1
Acacia dealbata	64	+
Monotoca scoparia	61	1
Stylidium graminifolium	61	1
Hardenbergia violacea	57	1
Cassinia aculeata	54	1
Acrotriche serrulata	50	1
Viola hederacea	50	+
Pteridium esculentum	50	1
Daviesia virgata	50	1
Dillwynia retorta	46	1

NO. OF SITES : 28 (3.9% of total)

DISTRIBUTION : Never distant from the backbone of the Great Dividing Range and concentrated within the watersheds of the Macalister and Wonnangatta Rivers, with a few isolated occurrences near Mt.Lookout, Aberfeldy and the Bowen Range.

ENVIRONMENT : Dry, rather exposed upland slopes, typically with a northerly aspect and and frequently steep. Water retention in the poorly structured, often shaly soils is low.

ALTITUDE : Mean = 761m, Highest = 1200m, Lowest = 420m.

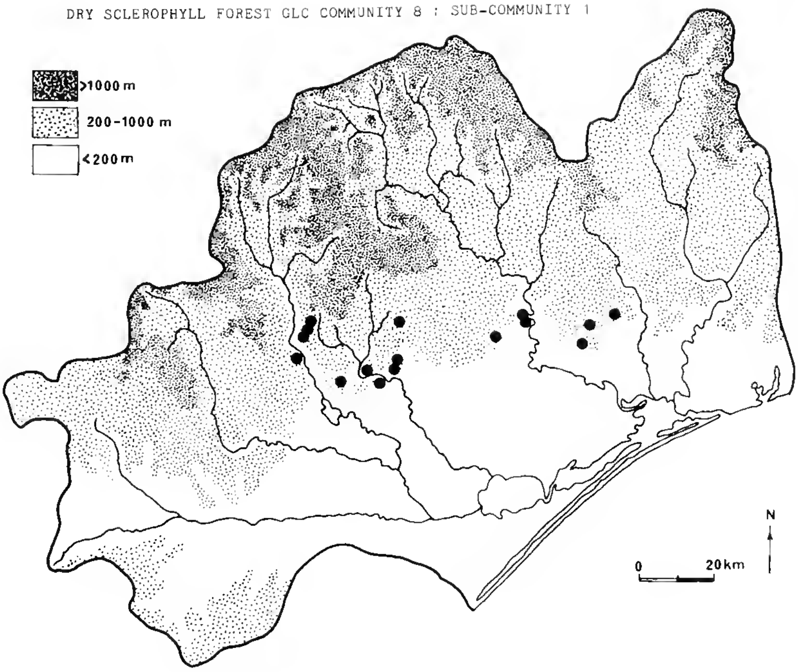
STRUCTURE : Woodland

MEAN FLORSITIC RICHNESS : 37 species per site

MEAN WEED COMPOSITION : 2% of species, 1% of cover

NOTES : A high proportion of dry slope species (e.g. *Eucalyptus dives, E. macrorhyncha, E. mannifera, Persoonia confertiflora, Hardenbergia violacea* etc.) appear in this community and similarly few plants of the wetter montane forests intrude. This sub-community has attracted little disturbance through either fire control measures or logging due to its open, sparse nature and lack of sawlog species.

DRY SCLEROPHYLL FOREST GLC COMMUNITY 8 : SUB-COMMUNITY 1



CHARACTER SPECIES	% FREQ.	C/A
Hydrocotyle hirta	94	1
Poa australis spp. agg.	94	1
Dichondra repens	82	1
Eucalyptus polyanthemos	82	1
Oxalis corniculata	82	+
Cassinia longifolia	76	2
Geranium potentilloides	76	1
Glycine clandestina	76	1
Hypericum gramineum	76	+
*Hypochoeris radicata	76	1
Lagenifera stipitata	71	1
Microlaena stipoides	71	1
Acacia mearnsii	65	1
Cheilanthes tenuifolia	65	1
Hibbertia obtusifolia	65	1
Senecio quadridentatus	65	1
Galium gaudichaudii	65	+
Luzula campestris spp. agg.	65	+
Gnaphalium japonicum	59	+
Billardiera scandens	59	+
Cymbonotus preissianus	59	1
Lepidosperma laterale	59	+
Stypandra glauca	59	1
Veronica plebeia	53	+
Leptospermum phylicoides	53	2
Lomandra longifolia	53	1
Phyllanthus hirtellus	53	+

NO. OF SITES : 17 (2.3% of total)

DISTRIBUTION : Mostly on slopes in the upper reaches of the Avon, Macalister, Mitchell and Nicholson River catchments.

ENVIRONMENT : Dry hills, often of northerly and north-easterly aspect.

ALTITUDE : Mean = 257m, Highest = 500m, Lowest = 70m.

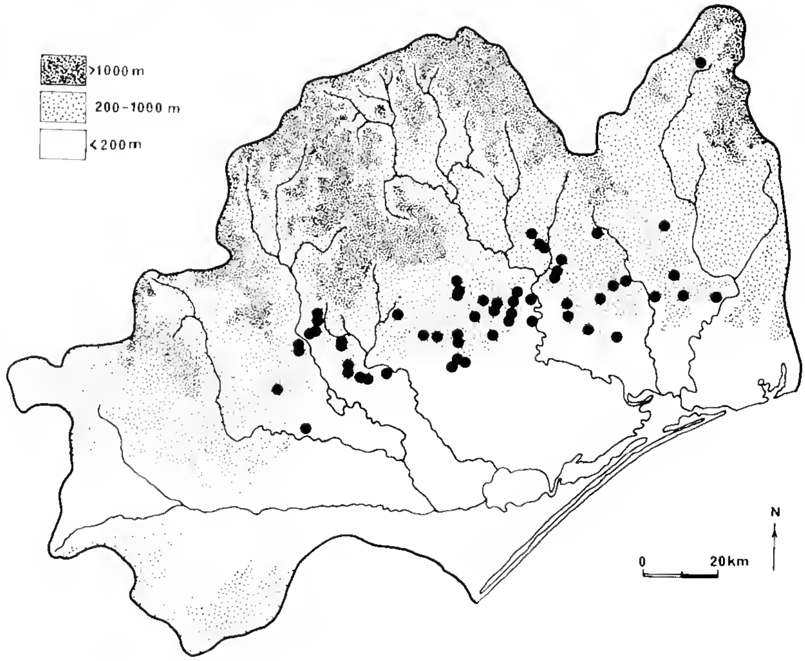
STRUCTURE : Open-forest to Woodland

MEAN FLORISTIC RICHNESS : 52 species per site

MEAN WEED COMPOSITION : 6% of species, 5% of cover

NOTES : The abundance of species such as *Cassinia longifolia*, *Hypericum gramineum*, *Hypochoeris radicata*, *Senecio quadridentatus* and *Luzula campestris* strongly suggest a history of fire and grazing for this type of vegetation. Nevertheless a large percentage of this floristically-rich vegetation maintains most of its original flora.

DRY SCLEROPHYLL FOREST GLC COMMUNITY 8 : SUB-COMMUNITY 2



CHARACTER SPECIES	% FREQ.	C/A
Cassinia longifolia	86	1
Lomandra longifolia	83	1
Poa australis spp. agg.	80	1
Hibbertia obtusifolia	68	1
Stypandra glauca	64	1
Eucalyptus polyanthemos	61	1
Lagenifera stipitata	59	1
*Hypochoeris radicata	59	1
Hypericum gramineum	54	+
Hydrocotyle hirta	54	1
Dianella revoluta	53	1
Acacia dealbata	51	1
Eucalyptus macrorhyncha	51	1
Lepidosperma laterale	47	1
Acacia falciformis	46	1
Gonocarpus tetragynus	44	1
Hardenbergia violacea	44	+
Acacia terminalis	44	1
Eucalyptus sieberi	42	1
Phyllanthus hirtellus	41	1
Viola hederacea	41	1
Microlaena stipoides	41	1
Epacris impressa	39	1
Eucalyptus globoidea	39	1
Galium gaudichaudii	39	+
Senecio quadridentatus	37	+
Persoonia confertiflora	37	+
Eucalyptus cypellocarpa	37	1
Cassinia aculeata	36	+

NO. OF SITES : 59 (8% of total)

DISTRIBUTION : Throughout the central and eastern foothills of the study area.

ENVIRONMENT : Dry hills, often of northerly and north-easterly aspect.

ALTITUDE : Mean = 352m, Highest = 660m, Lowest = 80m.

STRUCTURE : Open-forest to Woodland

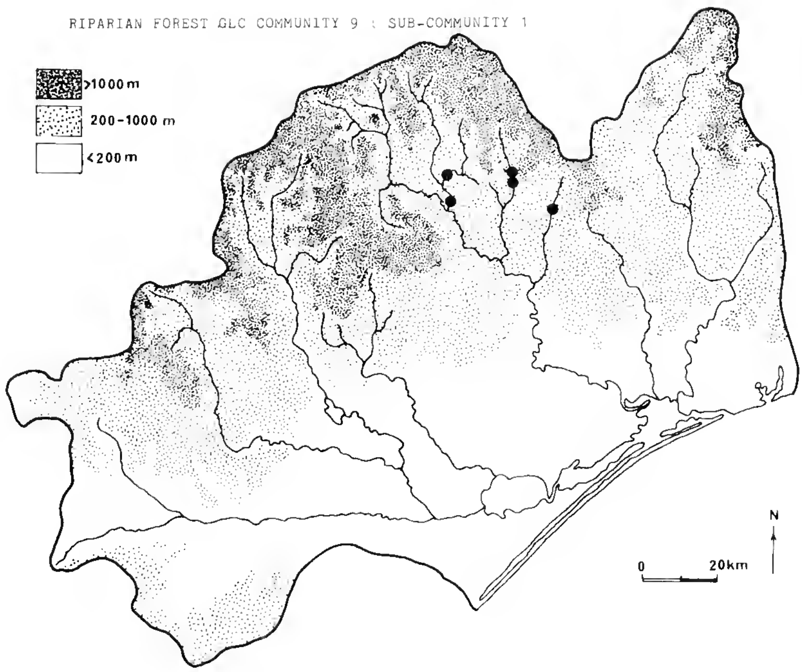
MEAN FLORISTIC RICHNESS : 35 species per site

MEAN WEED COMPOSITION : 2% of species, 2% of cover

NOTES : Sub-communities 8.1 and 8.2 are floristically very similar however the understorey of the latter is characterized by a lower abundance of herbs, (.e.g *Dichondra repens, Oxalis corniculata, Geranium potentilloides* are absent) and a higher abundance of small sclerophyllous shrubs (e.g. *Epacris impressa, Phyllanthus hirtellus, Hardenbergia violacea).*

There is also a suggestion of disturbance effects reflected in the low floristic richness of this sub-community when compared to sub-community 8.1.

RIPARIAN FOREST GLC COMMUNITY 9 : SUB-COMMUNITY 1



CHARACTER SPECIES	% FREQ.	C/A
Hymenanthera dentata	100	1
*Rubus fruticosus spp. agg.	100	1
Eucalyptus melliodora	83	1
Acacia dealbata	83	1
Acaena anserinifolia	83	1
Dichondra repens	83	1
Oxalis corniculata	83	1
*Rosa rubiginosa	83	1
Prunella vulgaris	67	1
Eucalyptus bridgesiana	67	1
Acacia mearnsii	67	1
Acacia melanoxylon	67	1
*Anagallis arvensis	67	+
*Cirsium vulgare	67	1
Eucalyptus viminalis	67	1
Geranium potentilloides	67	1
*Hypochoeris radicata	67	1
Leptospermum phylicoides	67	2
Pteridium esculentum	67	2

NO. OF SITES : 6 (8% of total)

DISTRIBUTION : Occurring on the Dargo, Wentworth and Crooked Rivers in the north of the study area.

ENVIRONMENT : Riparian vegetation of the higher part of this altitude range.

ALTITUDE : Mean = 343m, Highest = 540m, Lowest = 220m.

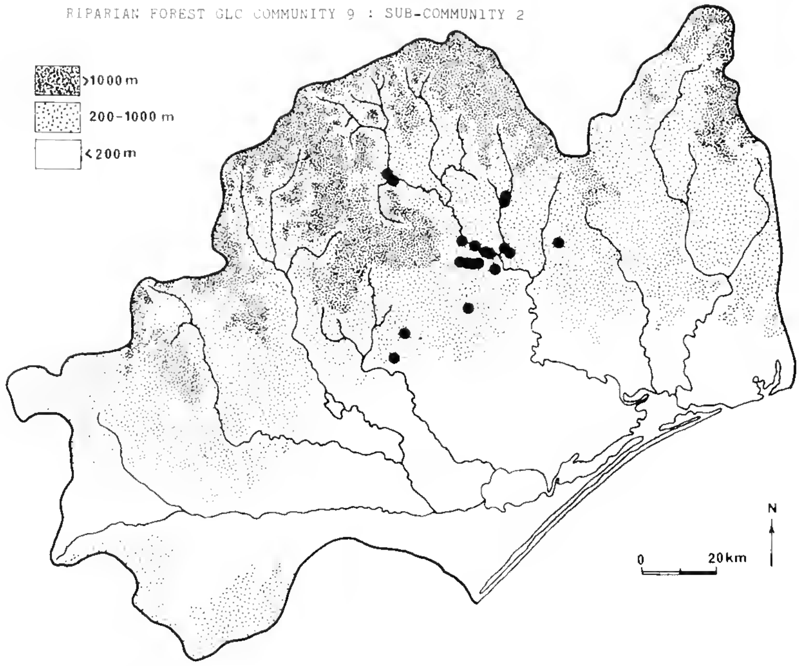
STRUCTURE : Open-forest

MEAN FLORISTIC RICHNESS : 44 species per site

MEAN WEED COMPOSITION : 22% of species, 22% of cover.

NOTES : This riparian vegetation occurs amongst otherwise dry hillsides of the Dargo region. Agriculture and mining have led to a high degree of disturbance with a number of introduced species such as *Rubus fruticosus* and *Rosa rubiginosa* being significant.

RIPARIAN FOREST GLC COMMUNITY 9 : SUB-COMMUNITY 2



CHARACTER SPECIES	% FREQ.	C/A
Poa australis spp. agg.	95	1
*Hypochoeris radicata	95	1
Rumex brownii	95	+
Echinopogon ovatus	90	1
Oxalis corniculata	90	+
*Anagallis arvensis	85	+
Dichondra repens	85	+
Glycine clandestina	85	+
Pteridium esculentum	80	1
Gnaphalium japonicum	80	+
*Conyza bonariensis	75	+
*Cirsium vulgare	75	+
Leptospermum phylicoides	75	2
Eucalyptus melliodora	75	1
Dichelachne micrantha	70	+
*Sonchus asper	70	+
Acaena anserinifolia	70	1
Cassinia longifolia	70	1
Cheilanthes tenuifolia	70	+
Hydrocotyle laxiflora	70	1
*Centaurium pulchellum	70	+
Microlaena stipoides	70	+
Luzula campestris spp. agg.	65	+
*Sonchus oleraceus	65	+
Acacia mearnsii	65	1
Agropyron scabrum	65	1
Urtica incisa	65	1
Carex appressa	60	1
Prunella vulgaris	60	1
*Hypericum perforatum	60	1
*Cerastium glomeratum	60	+
*Rubus fruticosus spp. agg.	60	1
Danthonia racemosa	60	1
Galium gaudichaudi	60	+
Hypericum gramineum	60	+
Plantago debilis	60	+
Eucalyptus bridgesiana	55	1
*Rosa rubiginosa	55	+
Poranthera microphylla	55	+
Hymenanthera dentata	55	1
Acacia dealbata	55	1
Clematis aristata	55	+
Hydrocotyle hirta	55	1
Rubus parvifolius	55	+
*Aira caryophyllea	50	+
Dichelachne crinita	50	+
Geranium retrorsum	50	1

CHARACTER SPECIES	% FREQ.	C/A
Stellaria pungens	50	1
*Trifolium repens	50	+
*Trifolium campestre	50	1
Acacia melanoxylon	50	1
Bursaria spinosa	50	1
Daucus glochidiatus	50	+
Lagenifera stipitata	50	+
*Vulpia bromoides	50	+

NO. OF SITES : 20 (2.8% of total)

DISTRIBUTION : Widespread in the central part of the study area centering on Dargo.

ENVIRONMENT : Riparian vegetation surrounded by dry hillsides.

ALTITUDE : Mean = 335m, Highest = 600m, Lowest = 180m.

STRUCTURE : Open-forest

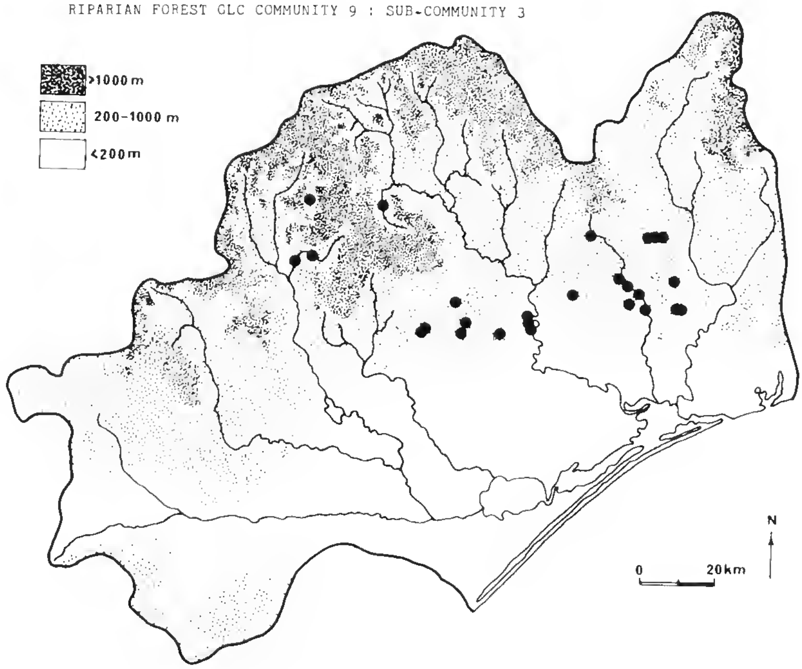
MEAN FLORISTIC RICHNESS : 75 species per site

MEAN WEED COMPOSITION : 21% of species, 20% of cover.

NOTES : This sub-community represents a seriously disturbed riparian vegetation, characterised by a large number of native and introduced weedy species. Most of these are herbs and reflect agricultural practice in the district. Many of the farms in the area are now derelict and most of sub-community 9.2 is on land of this type.

Sub-community 9.2 is floristically the richest vegetation of the study area. Although a significant proportion of its constituent species are introduced it still has the highest mean number of native species per site (60) of all vegetation types.

RIPARIAN FOREST GLC COMMUNITY 9 : SUB-COMMUNITY 3



CHARACTER SPECIES	% FREQ.	C/A
Pomaderris aspera	93	1
Dichondra repens	93	1
Poa australis spp. agg.	86	1
Geranium potentilloides	86	1
Pteridium esculentum	79	1
Adiantum aethiopicum	79	1
*Hypochoeris radicata	79	1
Viola hederacea	75	1
Acaena anserinifolia	75	1
Hydrocotyle hirta	75	1
Oxalis corniculata	75	+
Acacia dealbata	71	1
Lomandra longifolia	71	1
Clematis aristata	68	+
Cassinia aculeata	68	1
Leptospermum phylicoides	68	2
Cassinia longifolia	64	1
Coprosma quadrifida	64	1
Eucalyptus bridgesiana	64	1
*Rubus fruticosus spp. agg.	61	+
Acacia melanoxylon	61	1
Gnaphalium japonicum	61	+
Eucalyptus viminalis	61	1
Galium gaudichaudii	57	+
Stellaria flaccida	57	1
Blechnum nudum	54	1
Prostanthera lasianthos	54	1
Prunella vulgaris	54	1
Lagenifera stipitata	54	1
Stellaria pungens	54	1
*Centaurium pulchellum	50	+
Lepidosperma laterale	50	1
Carex appressa	46	1
Luzula campestris spp. agg.	46	+
Pimelea axiflora	46	+

NO. OF SITES : 29 (4% of total)

DISTRIBUTION : Widespread east of Glenaladale, also in the Mt.Tamboritha area.

ENVIRONMENT : Riparian vegetation

ALTITUDE : Mean = 283m, Highest = 680m, Lowest = 100m.

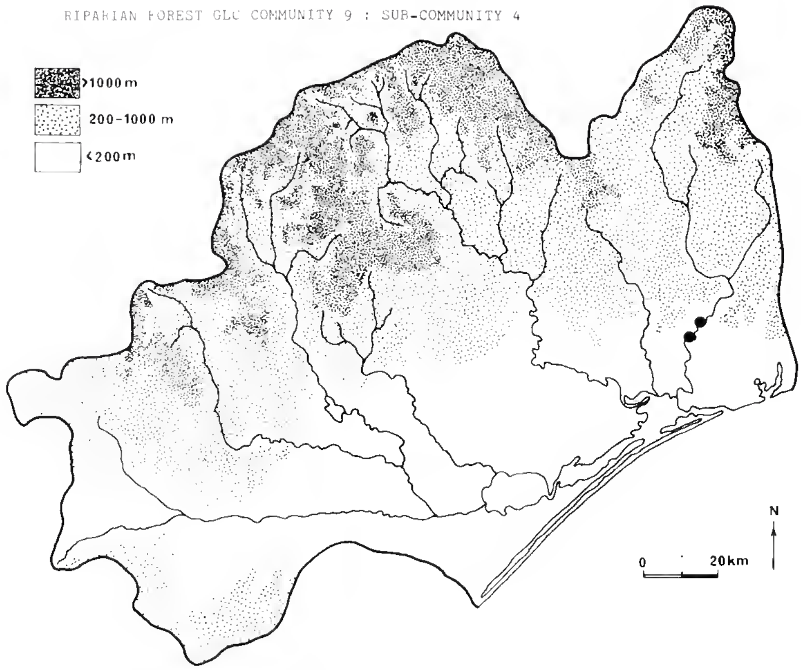
STRUCTURE : Open-forest

MEAN FLORISTIC RICHNESS : 51 species per site

MEAN WEED COMPOSITION : 7% of species,5% of cover

NOTES : Sub-communities 9.2 and 9.3 share a large number of species most of which are native. The major difference between these sub-communities is the large complement of introduced species in 9.2. Sub-community 9.2 therefore represents a disturbed (possibly re-established) form of 9.3 which has lost none of its native species. There are a number of other potential sites for this vegetation which are utilized for agriculture and possess only remnants of the original flora.

RIPARIAN FOREST GLC COMMUNITY 9 : SUB-COMMUNITY 4



CHARACTER SPECIES	% FREQ.	C/A
Acacia floribunda	100	1
*Cerastium glomeratum	100	1
*Cirsium vulgare	100	+
*Conyza bonariensis	100	1
*Dactylis glomerata	100	1
*Galium aparine	100	+
Geranium potentilloides	100	1
*Hypochoeris radicata	100	1
Leptospermum phylicoides	100	1
Phragmites australis	100	1
*Plantago lanceolata	100	1
Poa australis spp. agg.	100	2
Pteridium esculentum	100	1
Rubus parvifolius	100	1
*Acetosella vulgaris	100	1
*Rumex crispus	100	1
Veronica plebeia	100	+
*Vicia angustifolia	100	+
*Rubus fruticosus spp. agg.	100	1

NO. OF SITES : 2 (0.27% of total)

DISTRIBUTION : Both examples of this community were sampled on the banks of the Tambo River near Bruthen.

ENVIRONMENT : Close proximity to an intensive agricultural region and a large waterway.

ALTITUDE : Mean = 90m, Highest = 160m, Lowest = 20m.

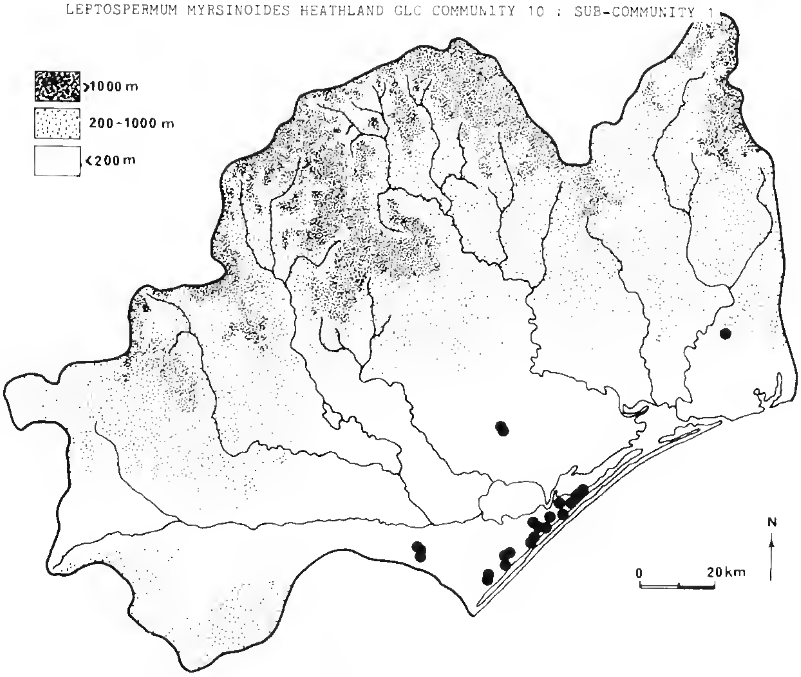
STRUCTURE : Low shrubland

MEAN FLORISTIC RICHNESS : 42 species per site

MEAN WEED COMPOSITION : 39% of species, 36% of cover.

NOTES : The sites on which this sub-community is found are highly disturbed by agriculture. It is probable that they once supported sub-community 9.3 vegetation.

LEPTOSPERMUM MYRSINOIDES HEATHLAND GLC COMMUNITY 10 : SUB-COMMUNITY 1



CHARACTER SPECIES	% FREQ.	C/A
Epacris impressa	100	1
Bossiaea cinerea	92	1
Banksia marginata	92	1
Lomandra longifolia	92	1
Monotoca scoparia	92	1
Leptospermum myrsinoides	88	2
Leucopogon ericoides	88	1
Acacia oxycedrus	88	1
Leucopogon virgatus	88	1
Banksia serrata	83	1
Pteridium esculentum	79	1
Caustis pentandra	75	1
Eucalyptus nitida	75	1
Leptospermum juniperinum	71	1
Hibbertia fasciculata	67	1
Hibbertia virgata	63	1
Amperea xiphoclada	58	+
*Hypochoeris radicata	58	+
Lepidosperma concavum	54	1
Brachyloma daphnoides	50	1
Dampiera stricta	50	1
Dillwynia glaberrima	50	1
Drosera peltata	50	+
Lomandra filiformis	50	1

NO. OF SITES : 25 (3.5% of total)

DISTRIBUTION : Mainly south and west from Sperm Whale Head on podzols developed from siliceous sands.

ENVIRONMENT : Flat or undulating areas beyond the influence of sea winds, on deep siliceous sands.

ALTITUDE : Mean = 23m, Highest = 160m, Lowest = 0m.

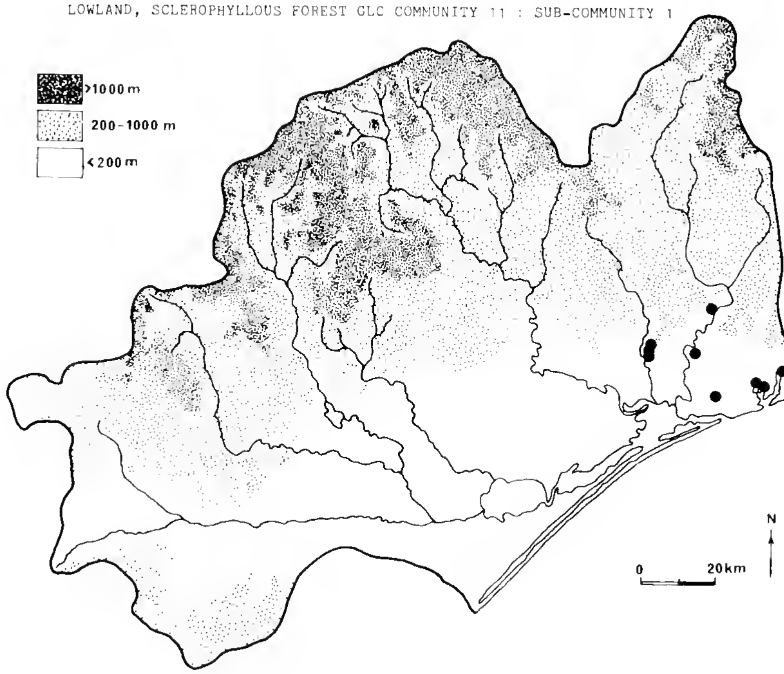
STRUCTURE : Low open-woodland to Closed heath.

MEAN FLORISTIC RICHNESS : 38 species per site

MEAN WEED COMPOSITION : 4% of species, 2% of cover

NOTES : This is a representative of a distinctive floristic community dominated by the small-leafed, sclerophyllous shrub *Leptospermum myrsinoides*. Most of the species in sub-community 10.1 are common in heathland vegetation throughout the State.

LOWLAND, SCLEROPHYLLOUS FOREST GLC COMMUNITY 11 : SUB-COMMUNITY 1



CHARACTER SPECIES	% FREQ.	C/A
Viola hederacea	100	1
Billardiera scandens	90	+
Lagenifera stipitata	90	1
Microlaena stipoides	90	1
Pteridium esculentum	90	2
Cassinia longifolia	80	1
Clematis aristata	80	1
Eucalyptus globoidea	80	2
Hibbertia obtusifolia	70	+
Poa australis spp. agg.	70	1
Acianthus exsertus	70	+
Eucalyptus cypellocarpa	70	1
Galium gaudichaudii	70	+
Hydrocotyle hirta	70	1
Luzula campestris spp. agg.	70	+
Olearia lirata	70	1
Goodenia ovata	60	1
Hibbertia aspera	60	1
*Hypochoeris radicata	60	1
Lomandra longifolia	60	1
Opercularia hispida	60	+
Senecio quadridentatus	60	+
Veronica plebeia	60	1

NO. OF SITES : 18 (2.5% of total)

DISTRIBUTION : Confined in the study area to the foothills within the Bruthen, Nowa Nowa and Lake Tyers region.

ENVIRONMENT : Dry conditions on the undulating land system which includes the tributaries of Lake Tyers. Soils are often deep sands but occasionally also include clays and gravelly soils.

ALTITUDE : Mean = 78m, Highest = 140m, Lowest = 20m.

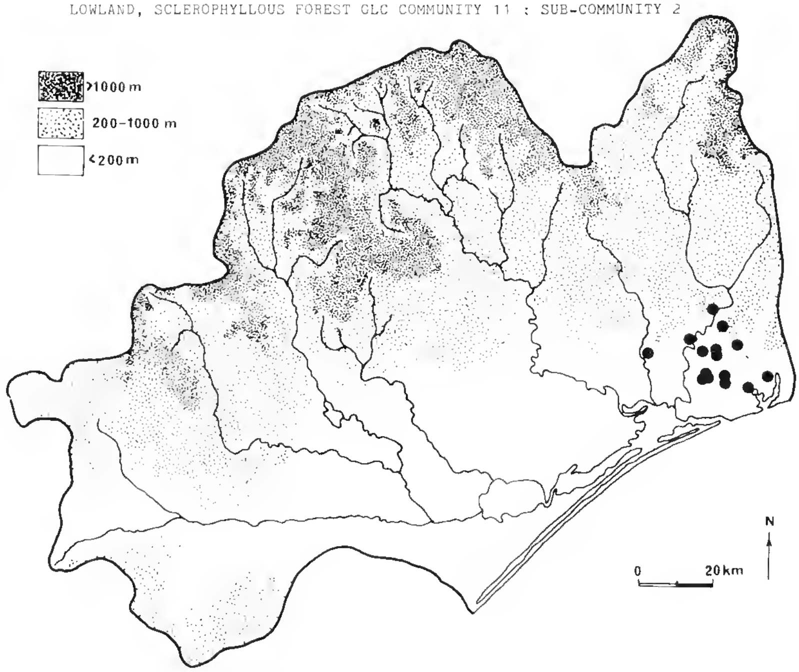
STRUCTURE : Open-forest

MEAN FLORISTIC RICHNESS : 46 species per site

MEAN WEED COMPOSITION : 3% of species, 2% of cover

NOTES : This restricted vegetation is intermediate in composition between the more coastal heaths and the open-forests of the foothills. Throughout most of its range sub-community 11.1 shows strong signs of disturbance by fire. Most understorey plants are small and young and *Pteridium esculentum* is the dominant understorey species in most sites.

LOWLAND, SCLEROPHYLLOUS FOREST GLC COMMUNITY 11 : SUB-COMMUNITY 2



CHARACTER SPECIES	% FREQ.	C/A
Epacris impressa	94	1
Gonocarpus teucrioides	94	1
Lomandra longifolia	94	1
Pteridium esculentum	94	2
Acrotriche serrulata	89	1
Persoonia linearis	89	+
Craspedia glauca	89	1
Tetratheca pilosa	83	1
Eucalyptus globoidea	83	2
Lagenifera stipitata	83	1
Xanthorrhoea minor	78	1
*Hypochoeris radicata	78	1
Eucalyptus sieberi	78	1
Hydrocotyle hirta	78	1
Phyllanthus hirtellus	72	1
Viola hederacea	72	1
Lomatia ilicifolia	72	+
Stypandra glauca	67	1
Hibbertia obtusifolia	67	1
Eucalyptus cypellocarpa	61	1
Acacia genistifolia	61	1
Senecio quadridentatus	61	+
Billardiera scandens	61	+
Poa australis spp. agg.	61	1
Hypericum gramineum	56	+
Microlaena stipoides	56	1

NO. OF SITES : 10 (1.4% of total)

DISTRIBUTION : The range of this community is effectively the same as that of 11.1 but is generally in closer proximity to water, such as Lake Tyers and the Nicholson River.

ENVIRONMENT : Dry conditions on the undulating land system which includes sub-community 11.1

ALTITUDE : Mean = 127m, Highest = 270m, Lowest = 50m

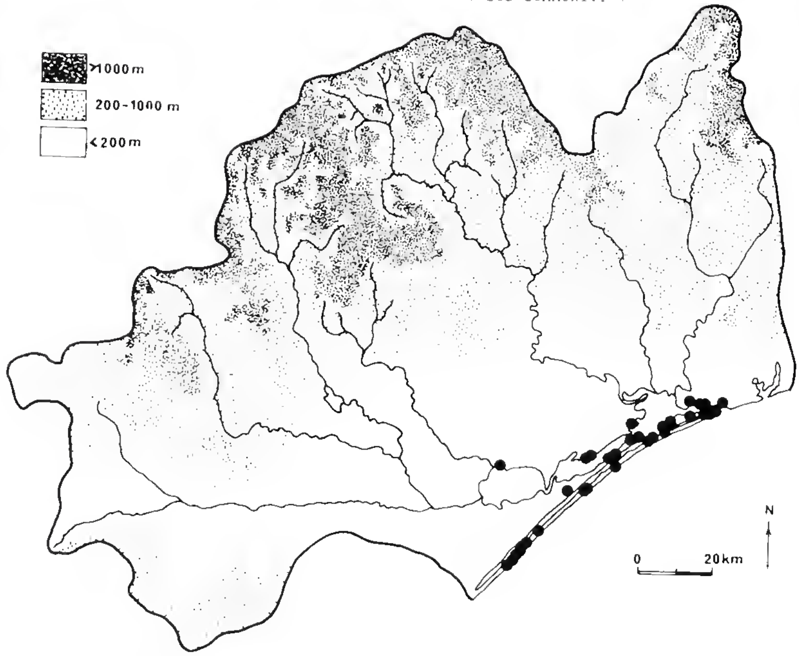
STRUCTURE : Open-forest

MEAN FLORISTIC RICHNESS : 47 species per site

MEAN WEED COMPOSITION : 2% of species, 1% of cover

NOTES : This sub-community is basically a more disturbed and species-poor version of sub-community 11.1. It contains few species not found in sub-community 11.1 and lacks *Eucalyptus sieberi* as well as a number of ground cover species.

COASTAL BANKSIA WOODLAND GLC COMMUNITY 12 : SUB-COMMUNITY 1



CHARACTER SPECIES	% FREQ.	C/A
Scirpus nodosus	88	1
Dichondra repens	86	1
*Hypochoeris radicata	86	1
Lomandra longifolia	83	1
Pteridium esculentum	76	2
Hydrocotyle hirta	69	1
Geranium potentilloides	67	1
Lagenifera stipitata	64	1
Oxalis corniculata	64	+
*Cerastium glomeratum	64	+
Crassula sieberiana	64	+
Banksia integrifolia	62	1
Ranunculus sessiliflorus	60	1
Tetragonia implexicoma	60	1
Melaleuca ericifolia	55	2
Microlaena stipoides	52	1
Cotula australis	52	1
Poa australis spp. agg.	52	1
Glycine clandestina	50	+
Rhagodia baccata	50	1
Lepidosperma concavum	50	1
Luzula campestris spp. agg.	50	+
Baumea juncea	45	1
Gonocarpus teucrioides	45	+
*Cirsium vulgare	43	+
Senecio spp.	43	1
Scirpus antarcticus	43	+
Acacia longifolia	40	1
Samolus repens	40	1
*Conyza bonariensis	40	+
Distichlis distichophylla	40	1
*Sonchus oleraceus	40	+

NO. OF SITES : 43 (6% of total)

DISTRIBUTION : Virtually all sites sampled were along the leeward side of the 90 Mile Beach dunes.

ENVIRONMENT : Protected secondary dunes inland from community 13. Soils are virtually pure calcareous sand with a minimal topsoil development.

ALTITUDE : Mean = 0m, Highest = 20m, Lowest = 0m.

STRUCTURE : Low open-woodland

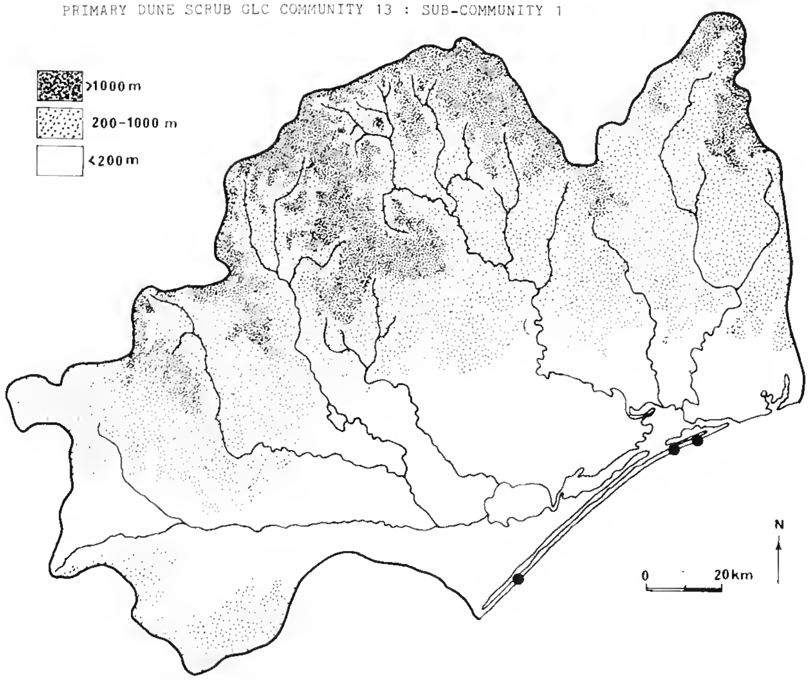
MEAN FLORISTIC RICHNESS : 44 species per site

MEAN WEED COMPOSITION : 14% of species, 10% of cover.

NOTES : This sub-community consists primarily of sclerophyllous plants growing on nutrient-poor calcareous sands. However, a small number of species which are found almost exclusively in the two or three metres immediately adjacent to the lake (e.g. *Samolus repens, Distichlis distichophylla*) are usually representative of a true salt marsh community (see Bridgewater,1975). This latter vegetation is poorly developed around the Gippsland Lakes and its components are therefore included in Community 12.

The past history of grazing on vegetation appears to have affected its floristic composition. Many introduced species have invaded sub-community 12.1 and make up (on average) 14% of its flora.

PRIMARY DUNE SCRUB GLC COMMUNITY 13 : SUB-COMMUNITY 1



CHARACTER SPECIES	% FREQ.	C/A
*Ammophila arenaria	100	3
Apium prostratum	100	+
Leucopogon parviflorus	100	+
Rhagodia baccata	100	1
Scirpus nodosus	100	1
Calocephalus brownii	67	1
Galium gaudichaudii	67	+
Spinifex hirsutus	67	1
Tetragonia implexicoma	67	1
Acacia longifolia	67	1
Clematis microphylla	67	1
Crassula sieberiana	67	+
Dichondra repens	67	1
*Hypochoeris radicata	67	+
Leptospermum laevigatum	67	2
Olearia axillaris	67	1
Oxalis corniculata	67	1
Pelargonium australe	67	1
Actites megalocarpus	67	1
*Sonchus oleraceus	67	+

NO. OF SITES : 3 (0.42% of total)

DISTRIBUTION : Distributed along the length of the 90 Mile Beach between Seaspray and Lakes Entrance.

ENVIRONMENT : Frontal dunes frequently exposed to strong, salt-laden winds.

ALTITUDE : Mean = 0m, Highest = 0m, Lowest = 0m.

STRUCTURE : Shrubland

MEAN FLORISTIC RICHNESS : 24 species per site

MEAN WEED COMPOSITION : 17% of species, 21% of cover.

NOTES : With the exception of the introduced Marram Grass (*Ammophila arenaria*), frequently planted as a sand-binder, this well-defined community is dominated by native species. The lack of disturbance to this community is probably a function of its inaccessibility (e.g. the almost entirely unroaded dune region of the 90 Mile Beach) which in turn demonstrates the fecundity and dispersal ability of *A. arenaria*. This grass and the native *Spinifex hirsuta* (the frequency of which seems to have decreased since the introduction of *A. arenaria* might be regarded among the most important species of the coastal areas. Their sand-binding ability stabilizes the dunes which afford protection from oceanic winds.

DATES OF PUBLICATION OF AUSTRALIAN PHARMACY JOURNALS IN CONNECTION WITH TAXONOMY

by

T. B. MUIR*

Pharmacists today rely very little on plants as a source of their medicinal drugs, but this was not the case last century, when botanists and pharmacists had a common interest in plants with medicinal properties. Ferdinand Mueller, Government Botanist in Victoria from 1853 to 1896, was one such botanist, and some of his new species were described in the various pharmacy journals published in that period. These journals are consequently of importance to present day plant taxonomists but the similarity of their titles has led to much confusion and they have frequently been misquoted in literature. Van Steenis (1950) brought welcome clarity to the situation although his paper lacked some details. The present author has examined the journals in the library of the Victorian College of Pharmacy, Melbourne, where complete sets are held, and has written this paper in order to provide further clarity.

The first Australian pharmacy journal of concern to taxonomists is *Quarterly Journal and Transactions of the Pharmaceutical Society of Victoria.* Only volumes 1 and 2 were issued, between 1858 and 1860. The next journal was *The Chemist and Druggist. With Australasian Supplement,* which commenced publication in 1878. It has sometimes been referred to as *Victorian Chemist and Druggist,* and *Melbourne Chemist and Druggist.* The history of this and the succeeding journals is given in van Steenis, as well as Anon. (1885), Anon. (1886), and Anon. (1934), to which reference should be made for details not included here. In volume 5, number 60, dated April 1883, the title was changed to *The Australasian Chemist and Druggist.* Volume numbers and part numbers continued on from the previous sequence. In 1886 it was re-titled *The Australasian Journal of Pharmacy,* the volume numbers recommencing at 1, and in 1972 its title was changed once more, this time to *The Australian Journal of Pharmacy,* which is still in publication. Van Steenis wrongly stated that the latter journal began in 1883. He was apparently referring to *The Australasian Chemist and Druggist.*

Another journal commenced in 1886, called *The Chemist and Druggist of Australasia,* which van Steenis wrongly recorded as still being published. Its title was changed in 1908 to *The Chemist and Druggist and Pharmacist of Australasia,* without any change in the sequence of the volume numbers. In 1934 it was merged with *The Australasian Journal of Pharmacy.*

These journals are listed below, together with *The Chemist and Druggist. London,* which has been confused with the Australian journals. Details concerning dates of publication are given only for those issues which contain articles of taxonomic importance. These issues were examined for reports of dated events, such as meetings, births and deaths, from which it was possible to establish a date after which each was published, but not a date before which it was published. To ascertain the latter it would be necessary to obtain corroborating evidence from other sources. Nevertheless it seems that generally each issue was published on or close to the date given on it, except for regular discrepancies in *The Chemist and Druggist. With Australasian Supplement,* q.v. below.

*National Herbarium of Victoria, Birdwood Avenue, South Yarra, Victoria 3141.

Muelleria 4(4): 385-387 (1981).

Quarterly Journal and Transactions of the Pharmaceutical Society of Victoria. Melbourne. v. 1—v. 2 (1858-59/60).

Eight parts, published at irregular intervals.

vol.	no.	pp.	dated	published after
2	5	1-56	1 April 1859	10 March 1859
2	6	57-100	1 July 1859	6 June 1859

The Chemist and Druggist. London. v. 1 (1859)+.

The Chemist and Druggist. With Australasian Supplement. Melbourne. v. 1—v. 5, no. 59 (1878/79-83).

Issued monthly, at first on the arrival of the English mail, then in volume 1 number 9 it was stated that the journal would henceforth be published on the fifteenth of each month. Each part bears the month as well as the year of publication, but there is ample evidence from the notices of events reported in the journal that the parts were issued at times other than the fifteenth of the month and often in the month following that printed on the cover. With the publication of volume 4 number 42 in October 1881 the journal began to appear regularly and the parts henceforth were issued in the month named on the cover, on or close to the fifteenth of the month.

vol.	no.	pp.	dated	published after
3	35	81-88	March 1881	7 April 1881
4	40	25-32	Aug. 1881	9 Sept. 1881
4	42	41-48	Oct. 1881	12 Oct. 1881
4	43	49-56	Nov. 1881	16 Nov. 1881
4	45	65-72	Jan. 1882	12 Jan. 1882
4	46	73-80	Feb. 1882	15 Feb. 1882
4	47	81-88	March 1882	13 March 1882
4	48	89-96	April 1882	5 April 1882
5	50	9-20	June 1882	9 June 1882
5	51	21-28	July 1882	13 July 1882
5	52	29-36	Aug. 1882	10 Aug. 1882
5	54	45-52	Oct. 1882	19 Oct. 1882
5	55	53-60	Nov. 1882	15 Nov. 1882
5	56	61-68	Dec. 1882	13 Dec. 1882
5	57	69-76	Jan. 1883	12 Jan. 1883
5	58	77-90	Feb. 1883	14 Feb. 1883
5	59	91-98	March 1883	14 March 1883

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Published on or close to the fifteenth of each month, as stated on the title pages.

vol.	no.	pp.	dated	published after
6	61	1-8	May 1883	9 May 1883
6	63	19-26	July 1883	10 July 1883
6	64	27-34	Aug. 1883	9 Aug. 1883
6	66	43-50	Oct. 1883	10 Oct. 1883
6	67	51-58	Nov. 1883	11 Nov. 1883
6	69	67-74	Jan. 1884	15 Jan. 1884
6	70	75-82	Feb. 1884	6 Feb. 1884
6	72	93-100	April 1884	13 April 1884
7	74	9-16	June 1884	8 June 1884
7	78	43-50	Oct. 1884	9 Oct. 1884
7	80	59-66	Dec. 1884	5 Dec. 1884
7	81	67-74	Jan. 1885	15 Jan. 1885
7	82	75-82	Feb. 1885	11 Feb. 1885
7	84	91-98	April 1885	12 April 1885
8	86	9-18	June 1885	10 June 1885
8	89	37-44	Sept. 1885	10 Sept. 1885
8	90	45-52	Oct. 1885	14 Oct. 1885

The Australasian Journal of Pharmacy. Melbourne. v. 1—v. 34 (1886-1919), n.s., v.1—v. 52 (1920-71).

Published on or close to the twentieth of each month, as stated on the title pages.

vol.	no.	pp.	dated	published after
1	2	45-80	Feb. 1886	16 Feb. 1886
1	3	81-122	March 1886	14 March 1886
1	4	123-160	April 1886	14 April 1886
1	6	199-238	June 1886	12 June 1886
1	7	239-274	July 1886	14 July 1886
1	8	275-318	Aug. 1886	13 Aug. 1886
1	9	319-360	Sept. 1886	14 Sept. 1886
1	11	397-444	Nov. 1886	15 Nov. 1886
1	12	445-480	Dec. 1886	14 Dec. 1886
2	13	1-40	Jan. 1887	14 Jan. 1887
2	14	41-80	Feb. 1887	17 Feb. 1887
2	15	81-120	March 1887	16 March 1887
2	16	121-162	April 1887	15 April 1887

The Australian Journal of Pharmacy. Melbourne. v. 53 (1972)+.

The Chemist and Druggist of Australasia. Sydney and Melbourne. v. 1—v. 23 (1886-1908).

Published on or close to the first of each month, as stated on the title pages.

vol.	no.	pp.	dated	published after
2	1	1-26	1 Jan. 1887	20 Dec. 1886
2	2	27-52	1 Feb. 1887	31 Jan. 1887
2	3	53-80	1 March 1887	24 Feb. 1887
2	4	81-114	1 April 1887	27 March 1887
2	5	115-144	1 May 1887	27 April 1887
2	6	145-176	1 June 1887	27 May 1887
10	10	207-230	1 Oct. 1895	27 Sept. 1895
11	10	215-242	1 Oct. 1896	25 Sept. 1896

The Chemist and Druggist and Pharmacist of Australasia. Melbourne. v. 24—v. 49, no. 7 (1909-34).

ACKNOWLEDGEMENT

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NOTES ON TEMPLETONIA R.Br. (PAPILIONACEAE)

by

J. H. Ross*

ABSTRACT

The identity of *Templetonia regina* J. Drummond is discussed and the species is relegated to synonymy under *Brachysema aphyllum* Hook. *Templetonia neglecta* J. H. Ross sp. nov. is described from Western Australia.

TAXONOMY

The name *T. regina,* which does not appear in Index Kewensis and which has been overlooked since it was published, appears in extracts of one of Drummond's letters (dated 3 Oct. 1844) published by W. J. Hooker in *J. Bot. & Kew Gard. Misc.* 5: 312 (1853). The very brief description supplied by Hooker is as follows:

> "For about seventy-five miles from the Moore River, we proceeded nearly due north over a rich grassy country, which exhibited little novelty, but was gay with the flowers of my *Lawrencella lanceolata,* one of the loveliest of plants . . . On the summit of a low bushy hill we discovered a charming Leguminous shrub, 3 or 4 feet high, and bearing brilliant scarlet flowers, nearly 2 inches long, varying to yellow, and which resemble those of a *Templetonia* more than any Australian genus I know. At present I have called it *T. regina,* for it is truly the queen of *Leguminosae.* Its seed-vessels are like those of *Jacksonia.*"

Hooker edited Drummond's letters fairly severely and omitted from the description some relevant information which further assists to identify *T. regina.* Drummond's actual letter, which is housed in the archives of the Herbarium of the Royal Botanic Gardens, Kew, reads as follows:

> ". . . on the top of a low bushy hill, in this grassy country we found a most beautiful leguminous shrub, growing 3 or 4 feet high with the stems of *Platylobium scolopendrium,* but with flowers nearly two inches long and of the most brilliant scarlet varying to yellow, they the flowers bear a greater resemblance to *Templetonia* than any other Australian genus I am acquainted with and although the seed vessels will no doubt supply generic distinction I for the present name the plant *T. regina* allied to the splendid plant, which may well be called the queen of Western Australian Leguminosae, at least in the form of the corolla, but with the seed vessels and other characters of *Jacksonia,* . . ."

"For the present . . ." might be considered to imply that Drummond was not definitely accepting the name but he did not actually say so. However, it is clear from Drummond's letter of 3 Oct. 1844 and from the following passage in a letter to W. J. Hooker dated 2 July 1847 that while Drummond accepted the plant as a new species for which he adopted the specific epithet "regina", he was initially unsure to which genus it belonged and subsequently changed his mind. Drummond wrote:

> " . . . I sent home in the collection of specimens nos. 26 & 37 two beautiful scarlet flowered leguminous plants I believe both new genera, I sent you both these plants in the last box no. 37 is the plant I called in my letter *Templetonia regina,* but the habit of the plant, as well as the seed vessel is quite different from *Templetonia,* and I wish to call it mackayii regina, *in compliment to our mutual friend J. T. Mackay of the College Botanic Garden Dublin,* when I lived in

*National Herbarium of Victoria, Birdwood Avenue, South Yarra, Victoria 3141.

Muelleria 4(4): 389-393 (1981).

Ireland Mr Mackay's house was a home to me when I happened to be in Dublin, and my late Brother was under many obligations to him, it would give me great pleasure to have a fine plant of my discovering bear his name, it will also associated among our Western Australian leguminosae, with Scot & Templeton who were both friends of his own, and fellow labourers in the same field . . . "

However, Hooker did not accede to Drummond's request as there is no mention of the name *Mackayia regina* in any extracts of Drummond's letters published subsequently. The reason for this is not known but perhaps it was because Hooker was aware of the already published genera *Mackaia* S. F. Gray (1821) and *Mackaya* Arn. (1838) or perhaps he merely overlooked the request when extracts of Drummond's letters were published in 1853.

Drummond's letters of 3 Oct. 1844 and 2 July 1847 provide additional clues to the identity of *T. regina* which is fortunate in view of the brief description published by Hooker. Reference was made in Drummond's letter of 2 July 1847 to his no. 37 being the plant he called *T. regina*. Drummond 4th coll. no. 37 was cited by Bentham, 'Fl. Austr.' 2: 12 (1864), as *Brachysema aphyllum* Hook., Curtis's Bot. Mag. t. 4481 (1849), and there are two specimens of Drummond's 4th coll. no. 37 in the Herbarium of the Royal Botanic Gardens, Kew, named *B. aphyllum* and three in the National Herbarium of Victoria. The plate (t. 4481) of *B. aphyllum* accords with Drummond's description and it is clear that *T. regina* is a later name for the plant described as *B. aphyllum*. Dr M. D. Crisp, Herbarium, National Botanic Gardens, Canberra, who is currently revising the genera *Brachysema* R. Br. and *Leptosema* Benth., has informed me that *B. aphyllum* is sufficiently distinct to be separated at generic level and that he intends to transfer the species to *Burgesia* F.Muell. However, as the required new combination in *Burgesia* has not yet been published for the species, *T. regina* is here reduced to synonymy under *Brachysema aphyllum* pending the publication of the new combination:

Brachysema aphyllum Hook., *Curtis's Bot. Mag.* t. 4481 (1849).

Templetonia regina J. Drummond, *J. Bot. & Kew Gard. Misc.* 5: 312 (1853), synon. nov. Type: Western Australia, ± 120 km from Moore River, J. Drummond 4th coll. no. 37 (K, MEL).

Templetonia neglecta J. H. Ross, sp. nov., affinis incertae; ab omnibus speciebus differt.

Frutex usque ad 0.9 m altus, glabra, inermis. Folia simplicia; lamina (0.45) 0.7-2.2 (3.8) cm longa, 0.2-0.5(0.7) cm lata, oblonga vel plus minusve obovata-oblonga, apice apiculata, glabra, costa subtus satis obvia. Stipulae inconspicuae. Flores axillares, solitarii; pedicelli usque ad 0.7 cm longi; bracteae ad basim pedicellorum usque ad 0.5 mm longae; bracteolae usque ad 1.3 mm longae. Calyx usque ad 6 mm longus. Corolla luteola: vexillum suborbiculare, 9.5-15 mm longum, 7.5-12.5 mm latum; carina et alae usque ad 12 mm longae, unguiculatae. Stamina 10; filamenta in columnam antice fissam connata. Ovarium usque ad 6 mm longum, glabrum. Legumina oblonga, 2.2-2.6 cm longa, 0.9-1.1 cm lata, glabra. Semina elliptica, 4.5-5.8 mm longa, 2.6-3.2 mm lata.

Glabrous *shrub* up to 0.9 m high with several stems arising from a woody rootstock; *young stems* green, ± terete or distinctly ridged and somewhat angular, unarmed. Stipules inconspicuous, up to 1 mm long, broad basally and tapering apically. *Leaves* simple, articulated basally, oblong to slightly obovate-oblong, upper surface usually somewhat concave in section, (0.45) 0.7-2.2 (3.8) × 0.2-0.5 (0.7) cm, glabrous, midrib raised and conspicuous beneath, projecting slightly beyond the apex of the leaf as a short mucro, with a mass of fine glandular processes in the axils. *Flowers* 1 per axil, on glabrous pedicels 4-7 mm long, the pedicels with a basal bract ± 0.5 mm long and a pair of glabrous bracteoles 1-1.5 mm long from about the middle to near the apex. *Calyx* green, up to 6 mm long, the two upper lobes fused for almost their entire length, the lowest lobe longest, glabrous except for a fringe of hairs on the apex of the lobes. *Standard* orbicular, 9.5-15 mm long including a claw up to 3.5 mm long, 7.5-12.5 mm wide, reflexed, emarginate apically,

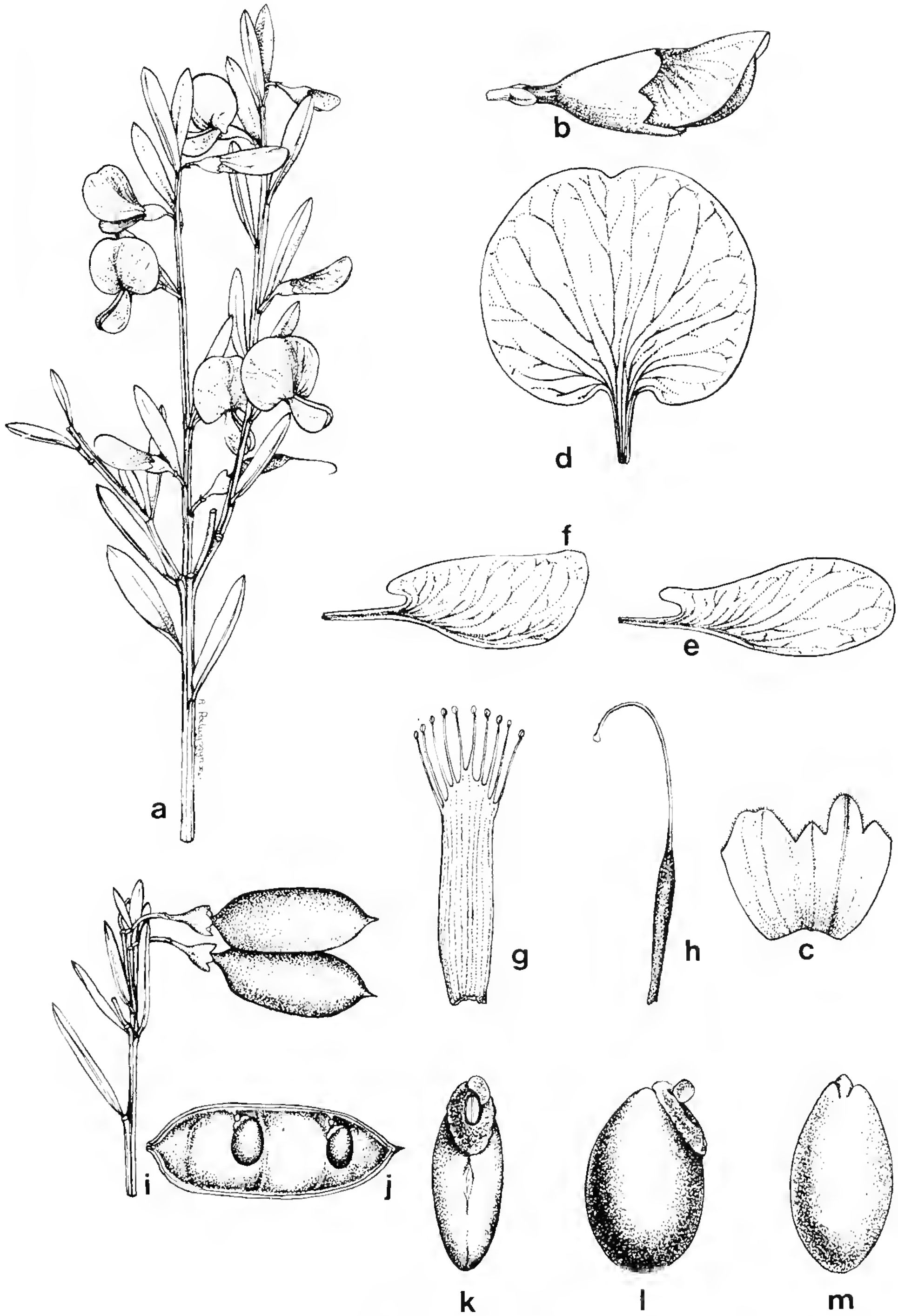

Fig. 1. *Templetonia neglecta.* a—flowering twig, x 1; b—side view of flower showing the paired bracteoles, x 3; c—calyx opened out (upper lobes on left), x 3; d—standard, x 3; e—wing petal, x 3; f—keel petal, x 3; g—staminal tube opened out, x 3; h—gynoecium, x 3, a-h from Newbey 4273 (PERTH); i—fruiting twig, x 1; j—valve of pod showing seeds, x 1½, i & j from Newbey 2775 (PERTH); k—seed, hilar view, x 5; l—seed, side view, x 5; m—outline of embryo showing straight radicle, x 5, k-m from A. S. George 7236 (PERTH).

dull lightish brown outside with dull yellow venation, dull yellow inside with a darker yellow basal horse-shoe shaped throat surrounded by a narrow dull light brown margin (fide Newbey 4273); *wings* 8.5-12 mm long including a claw up to 2.5 mm long, 2.5-4.5 mm wide, auricled, dull light brown outside; *keel* petals lightly united, 9-12 mm long including a claw up to 3.5 mm long, 3.5-4.8 mm wide, auricled, dull light brown outside. *Stamens* 10.5-12.5 mm long, the filaments joined in a sheath split open on the upper side, anthers alternately basifixed and dorsifixed. *Ovary* up to 6 mm long including the stipe, 4-6-ovulate, glabrous; style slender, curved, with a small terminal stigma. *Pod* oblong, on a stipe as long as or just exceeding the persistent calyx, $2.2\text{-}2.6 \times 0.9\text{-}1.1$ cm, with an acute apical beak, 3-5-seeded, valves convex, coriaceous, glabrous, splitting along both sutures. *Seeds* elliptic, $4.5\text{-}5.8 \times 2.6\text{-}3.2$ mm and 1.5-2.1 mm thick, yellowish-brown, with a small hilum surrounded by a collar-like aril, the aril with a raised lateral lip.

TYPE COLLECTION: Western Australia, 11 km N.W. of Black Head, 34°31′S, 118°48′E, *K. Newbey 4273,* 6.viii.1974 (PERTH, holo.!).

ALSO EXAMINED:

Western Australia—near Cape Arid, *Maxwell,* 1875 (MEL 92091). 28 miles S. of Ravensthorpe, *E. Wittwer 412,* 27.viii.1965 (PERTH). W. end of Eyre Range, S. of Ravensthorpe, *A. S. George 7236,* 2.xi.1965 (PERTH). Eucla Division, Esperance Distr., 3 km N.W. of Young River crossing on Ravensthorpe-Esperance main road, *N. N. Donner 2774,* 25.ix.1968 (AD 97118033). 22 miles S. of Jerramungup, *K. Newbey 2775,* 16.xi.1968 (PERTH). 17 miles W. of Bremer Bay, *K. Newbey 2843,* 22.viii.1969 (PERTH).

T. neglecta is a rare species with a restricted distribution in the Southwestern Botanical Province of Western Australia being confined to the Eyre Botanical District as defined by Beard (1980) where it has been recorded from loam, loamy clay and rocky sand (quartzite). Although the first specimen was collected by Maxwell in 1875, ninety years apparently elapsed before the species was re-collected. Only seven collections of *T. neglecta* have been made to date and further material would be welcomed.

The species lacks any outstanding characteristic which may account for it not having been described previously. According to Mr. K. Newbey plants are inconspicuous, expecially when not in flower, and have the appearance of straggly specimens of *Gastrolobium crassifolium* Benth. with only a few leaves. Flowers are produced from early June to early September and individual plants are reported to flower for long periods. Regeneration is mainly by suckering after a fire or earth disturbance.

T. neglecta shows no obvious affinity with any other *Templetonia* species in Western Australia although some sterile small-leaved specimens of *T. retusa* show a fairly close superficial resemblance to sterile specimens of *T. neglecta.* However, *T. retusa* is a very distinctive unrelated species which is readily distinguished from *T. neglecta* when in flower or fruit. *T. neglecta* appears to be most closely related to *T. stenophylla* which occurs in eastern South Australia, Queensland, New South Wales and Victoria and from which it is separated by a large geographical discontinuity. *T. stenophylla* differs in that the plants are sometimes weak-stemmed and straggling, the leaves tend to be larger, not as congested on the stems and of a different shape and texture, the flowers are solitary or paired in the leaf axils, and the pods are usually slightly obliquely oblong-elliptic with a lateral apical beak and on a stipe up to 5 mm long which exceeds the persistent calyx.

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subsequently locating a reference to *T. regina* in J. Drummond's correspondence and for suggesting the possible identity of the species; to Dr A. A. Munir, currently Australian Botanical Liaison Officer, Royal Botanic Gardens, Kew, for copying out the relevant portions of Drummond's letters housed in the Kew archives and for photographing some of the specimens of *Brachysema aphyllum* housed at Kew, to Mr Ken Newbey, Ongerup, Western Australia, for kindly providing his detailed description and field notes of *T. neglecta,* to Miss A. M. Podwyszynski, National Herbarium of Victoria, for preparing the accompanying illustration, and to the Curator, Western Australian Herbarium and Chief Botanist, State Herbarium of South Australia, for the loan of specimens.

REFERENCE

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POLLEN-OVULE RATIOS, BREEDING SYSTEMS AND DISTRIBUTION PATTERNS OF SOME AUSTRALIAN GNAPHALIINAE (COMPOSITAE: INULEAE)

by

P. S. Short *

ABSTRACT

Pollen-ovule ratios (P/O's) were used to determine the breeding systems of 24 species in 13 genera of the subtribe Gnaphaliinae (Compositae: Inuleae). In many cases where P/O's were determined for 3 or more widely separated populations within a species P/O values were very uniform and species were readily classed as either outbreeders (P/O's = c.1,500-6,000) or inbreeders (P/O's = c.40-350). P/O variation between populations is discussed.

Changes from outbreeding to inbreeding were recognized in some closely related taxa of *Actinobole, Angianthus, Blennospora, Chrysocoryne, Chthonocephalus* and *Pogonolepis*. Character differences often associated with such changes include narrow vs wide distribution range, diploidy vs polyloidy, tetrasporangiate vs bisporangiate anthers and pentamerous vs tri- or tetramerous florets. Derived inbreeding taxa were generally widespread across much of Australia while their outbreeding congeners were restricted to parts of Western Australia. The data suggest that the inbreeding taxa originated in that state and subsequently spread eastwards. The salt lake systems of the south-west of Western Australia may have been important reservoirs from which colonization of the arid zone has occurred.

The following new combinations have been made: *Actinobole condensatum* (A. Gray) Short, *Blennospora phlegmatocarpa* (Diels) Short, *Pogonolepis muellerana* (Sond.) Short and *Siloxerous pygmaeus* (A. Gray) Short.

INTRODUCTION

Cruden (1977), on the basis of data from 96 populations representing 80 species and approximately 30 families, has shown that pollen-ovule ratios (P/O's) are a good conservative indicator of a flowering plant's breeding system. Further data supporting the use of P/O's have been presented by Lloyd (1965), Baker (1967), Gibbs et al. (1975), Cruden (1976 a, b), Schoen (1977), Cruden and Hermman-Parker (1979) and Spira (1980).

Merxmuller et al. (1977) drew attention to the lack of biosystematic studies in the Inuleae. In order to complement taxonomic revisions, P/O data, and thus breeding system data, have been determined for a number of endemic Australian taxa belonging to the tribe Inuleae (Compositae). Such data, along with chromosome number determinations, have led to a new understanding of the relationships and distribution patterns exhibited by many of the species and genera examined. It is hoped that the data obtained for the Compositae will be of interest to students of this family and workers in Australian biogeography and illustrate the value of P/O's in biosystematic and biogeographic studies.

Initial taxonomic investigations of the Inuleae by the present author were centred on members of the subtribe Angianthinae, one of nine subtribes recognised by Bentham (1873). Merxmuller et al. (1977) referred the majority of the members of the subtribe to an "*Angianthus* group" of the substribe Gnaphaliinae. While the alignment of the various genera with others such as *Helichrysum* Miller and

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Muelleria 4(4): 395-417 (1981).

Helipterum DC. seems reasonable the group is nevertheless artificial, with genera being grouped together primarily because of their characteristic compound heads or glomerules. This condition occurs in a number of unrelated genera in the Compositae and is perhaps a result of selection for more efficient pollination or for a shorter life cycle. In the genera studied a reduction in life span is likely, many species being annuals living in arid or semi-arid conditions. In any case the Australasian "*Angianthus* group" contains genera which are probably not as closely related as current classification suggests, preliminary studies clearly indicating the need for critical revisions of the currently recognised genera of Gnaphaliinae. For example, studies in the genus *Angianthus* Wendl. (sensu Bentham, 1867) suggest that c.10 segregate genera should be recognized (Short, in press), a conclusion more or less in accord with a previous treatment of the Angianthinae by Gray (1851). Thus in this paper *Chrysocoryne* Endl., *Dithyrostegia* A. Gray, *Epitriche* Turcz., *Hyalochlamys* A. Gray, *Pogonolepis* Steetz and *Siloxerus* Labill. are recognised. Other genera of the "*Angianthus* group", e.g. *Actinobole* Fenzl ex Endl., *Blennospora* A. Gray and *Chthonocephalus* Steetz, have also been examined and P/O distribution data are outlined for members of these genera plus various other taxa belonging to the subtribe Gnaphaliinae.

The subtribe Gnaphaliinae (sensu Merxmuller et al., 1977) consists of perhaps 95-100 genera and has a world-wide distribution, the main centres of diversity being in South America and Australia. Smaller centres occur in South Africa and the Mediterranean. Because of the artificiality of the "*Angianthus* group", elaboration of its general distribution is somewhat meaningless. However, in the sense of Merxmuller et al. (1977), the group is considered to be endemic to Australasia and it is of interest that many of the genera studied have their apparent centre of diversity in Western Australia. Indeed some, e.g. *Siloxerus* (3 spp.), *Cephalosorus* (1 sp.), *Dithyrostegia* (1 sp.), *Epitriche* (1 sp.) and *Hyalochlamys* (1 sp.) are endemic to the south-west of the state. The presence of some monotypic genera, of which relationships are at present obscure, suggests that some entities are relictual. This contrasts with the majority of taxa examined below, where it is suggested that at least the derived inbreeding species are probably of quite recent origin.

MATERIALS AND METHODS

To determine pollen-ovule ratios of hermaphroditic species all pollen grains were counted in a single floret taken from, usually, each of 15 individuals of a population. Whenever possible counts were obtained from 3 or more populations, all individual counts being combined to give an average P/O for the species.

To count pollen mature but indehisced anthers were removed from florets and mounted in a solution of safranin or double stain (methyl green and phloxine: Owcarzac, 1952) and glycerin jelly. On squashing, mature anthers readily discharged their pollen grains which were then counted by using a grid in the eye piece of the misroscope. The use of a cytoplasmic stain also enabled estimation of percentage pollen fertility although in the taxa examined no significant infertility was observed.

As there is a single ovule per floret in the Compositae the pollen-ovule ratio in hermaphroditic species is equal to the number of pollen grains per floret. To determine P/O's of andromonoecious and gynomonoecious taxa it was necessary to determine the ratio of male or female to bisexual florets. To accomplish this the number of bisexual and unisexual florets were counted in a single capitulum of each individual from which pollen was counted and the average percentages of unisexual and bisexual florets for a population were determined.

Voucher specimens of plants used for detailed pollen counts are housed in the State Herbarium of South Australia (AD).

Chromosome counts were obtained from either bud material fixed in the field or root tips obtained from freshly germinated seeds. A full account of the chromosome data will be published elsewhere.

Distribution maps have been compiled from specimens housed in the following herbaria (abbreviations after Holmgren and Keuken, 1974): AD, BRI, CANB, CBG, K, KP (Kings Park, Western Australia), MEL, NSW, NT, PERTH and UWA.

Several species found during the course of these studies are yet to be described and are referred to by capital letters, e.g. *Chrysocoryne* sp. A. Four new combinations have also been required (see appendix I). Thus *Calocephalus phlegmatocarpus* Diels has been transferred to *Blennospora* A. Gray, *Gnaphalodes condensatum* A. Gray to *Actinobole* Fenzl ex Endl., *Skirrhophorus muelleranus* Sond. to *Pogonolepis* Steetz and *Chamaesphaerion pygmaeus* A. Gray to *Siloxerus* Labill.

RESULTS

Pollen-ovule data of species examined are summarised in table 1 and figure 1. Table 2 contains a summary of the character differences frequently found to occur between the closely related outbreeding and inbreeding species examined. Appendix 2 contains information pertaining to individual populations from which data were obtained while appendix 3 contains t-test results from paired comparisons of the P/O's of populations of each species.

Apart from andromonoecious *Helipterum pygmaeum* (DC.) Benth. and gynomonoecious *Helichrysum tepperi* F. Muell. all species examined in this paper are hermaphroditic and, with the exception of *Angianthus cunninghamii* (DC.) Benth., are annuals.

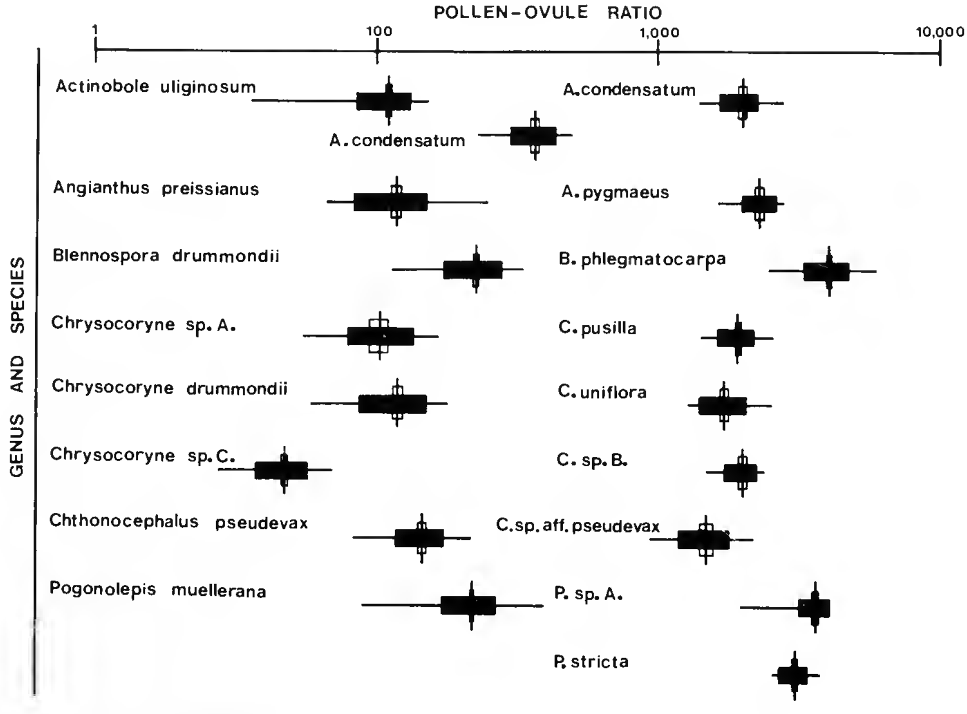

Fig. 1. Mean, range, standard deviation and standard error of pollen-ovule ratios of species of Gnaphaliinae.

Species	Pollen-ovule ratio				
	Mean	± Standard Deviation	± Standard Error	Number of individuals	Number of populations
Actinobole condensatum	2,037.4	357.4	68.7	27	2, 1 in part only
Actinobole condensatum	373.1	70.7	16.6	18	2, 1 in part only
Actinobole uliginosum	110.8	23.8	2.3	101	7
Angianthus pygmaeus	2,345.4	330.3	85.2	15	1
Angianthus preissianus	119.7	35.5	4.5	60	4
Blennospora phlegmatocarpa	4,119.7	762.4	113.6	45	3
Blennospora drummondii	231.0	53.7	6.2	75	5
Chrysocoryne pusilla	1,967.0	306.3	45.6	45	3
Chrysocoryne sp.B.	2,043.6	278.3	71.8	15	1
Chrysocoryne uniflora	1,777.5	354.1	91.4	15	1
Chrysocoryne drummondii	121.9	33.7	5.0	45	3
Chrysocoryne sp.A.	105.8	34.3	8.8	15	1
Chrysocoryne sp.C.	48.6	10.5	1.5	45	3
Chthonocephalus sp. aff. pseudevax	1,539.0	314.0	81.0	15	1
Chthonocephalus pseudevax	150.7	29.1	3.7	60	4
Helipterum demissum	84.6	18.1	3.3	30	2
Millotia tenuifolia	154.9	29.2	7.5	15	1
Myriocephalus rhizocephalus	107.6	23.1	5.9	15	1
Pogonolepis stricta	3,185.4	397.7	102.6	15	1
Pogonolepis sp.A.	3,761.4	516.7	133.4	15	1
Pogonolepis muellerana	227.2	51.8	5.4	90	6
Rutidosis multiflora	33.4	10.9	1.6	45	3
Toxanthes muelleri	86.0	19.4	5.0	15	1
Helichrysum tepperi	c. 37.5	—	—	15	1
Helipterum pygmaeum	c. 252	—	—	15	1

Table 1. Pollen-ovule ratios of species of Gnaphaliinae.

Outbreeder	Inbreeder	Species
High pollen-ovule ratio	Low pollen-ovule ratio	Actinobole condensatum/A. uliginosum Angianthus pygmaeus/A. preissianus Angianthus drummondii/A.preissianus Blennospora phlegmatocarpa/B. drummondii Chrysocoryne spp. Chthonocephalus sp. aff. pseudevax/C. pseudevax Millotia spp. Pogonolepis spp.
Anther sac long	Anther sac c. half as long	As above
Anthers tetrasporangiate	Anthers bisporangiate	As above
Florets pentamerous	Florets tri- or tetramerous	As above
Laminae of capitula bracts conspicuous	Laminae of capitular bracts less conspicuous	Actinobole condensatum/A. uliginosum
Inflorescence strongly scented	Inflorescence weakly scented	Blennospora phlegmatocarpa/B. drummondii
Protandrous	Protogynous	?Blennospora phlegmatocarpa/B.drummondii
Diploid	Polyploid	Chrysocoryne spp. Pogonolepis spp.
Restricted distribution	Wide distribution	Actinobole condensatum/A. uliginosum Angianthus pygmaeus/A. preissianus Angianthus drummondii/A. preissianus Blennospora phlegmatocarpa/B.drummondii Chrysocoryne spp. (p.p.) Chthonocephalus sp. aff. pseudevax/C.pseudevax Pogonolepis spp. (p.p.)

Table 2. Summary of character differences found to occur between related outbreeding and inbreeding species of Gnaphaliinae.

Actinobole Fenzl ex Endl.

This genus contains 2 species, *A.condensatum* (A. Gray) Short and *A.uliginosum* (A. Gray) Hj. Eichl. The former species is confined to Western Australia, occurring between latitudes c.24°S and 30°30'S and west of longitude c.116°E. It commonly grows in red sandy soil in open *Acacia-Ptilotus* shrubland but has also been collected on the coast, growing with *Carpobrotus, Calandrinia* etc. in white quartzite sand (*Short 380*). On the other hand the inbreeding *A.uliginosum,* with an average P/O = 110.8, is widely distributed across much of mainland Australia, occurring between latitudes c.22°S and c.38°S and west of longitude c.151°E (fig. 2). The species frequents a variety of habitats including granite outcrops, mallee scrub and the upper margins of salt lakes.

The capitular bracts of *A.condensatum* have larger laminae than those found in *A.uliginosum.* Differences in anther sac size and the occasional presence of tetramerous florets in *A.uliginosum* also reflect the different breeding systems displayed by the 2 species.

Both species of *Actinobole* possess an extremely efficient method of cypsela dispersal. The pappus in both species usually consists of 5-6 stiff bristles which, in the intact capitulum, lie parallel to the corolla tube. As the capitular bracts weaken at maturity the pappus bristles suddenly reflex, shooting the cypselas from the capitulum and dispersing them around the plant.

The most significant observation in the genus is the presence of 2 different P/O's within *A.condensatum.* The data suggest that northern populations of the species are primarily outbreeders with average P/O's of c.2,000. In contrast the southern populations sampled display an average P/O of several hundred. A single sample (*Short 393*) from a population located near the centre of the species distribution con-

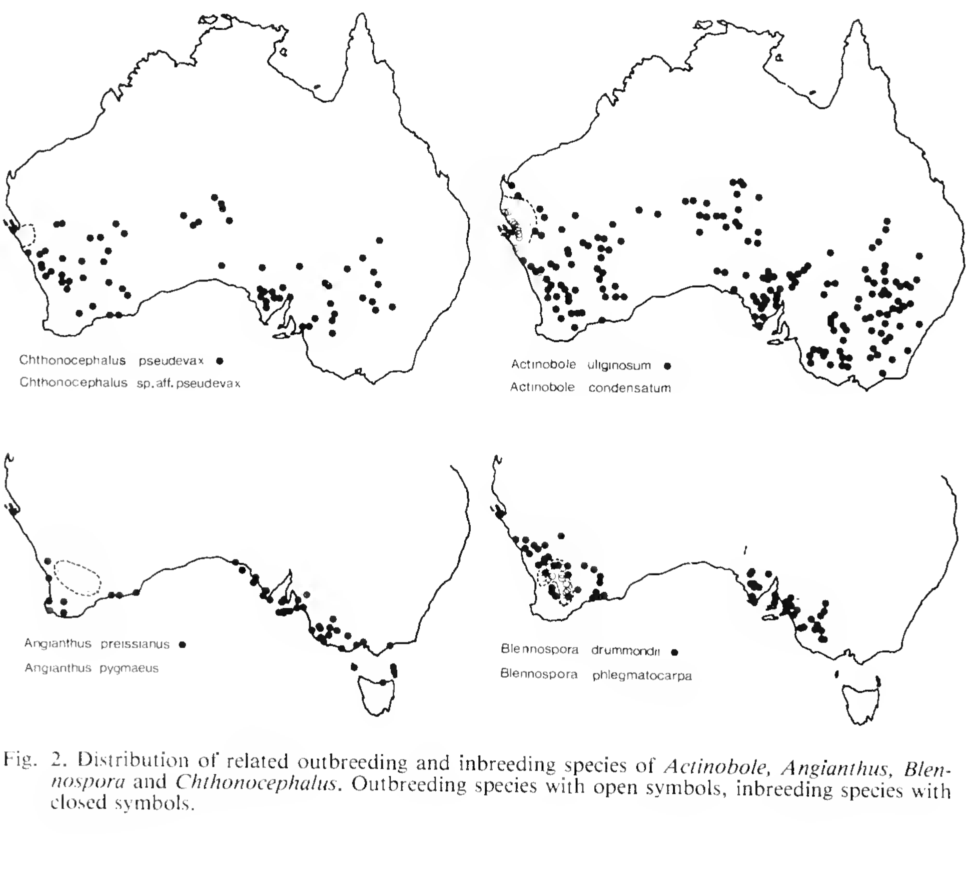

Fig. 2. Distribution of related outbreeding and inbreeding species of *Actinobole, Angianthus, Blennospora* and *Chthonocephalus.* Outbreeding species with open symbols, inbreeding species with closed symbols.

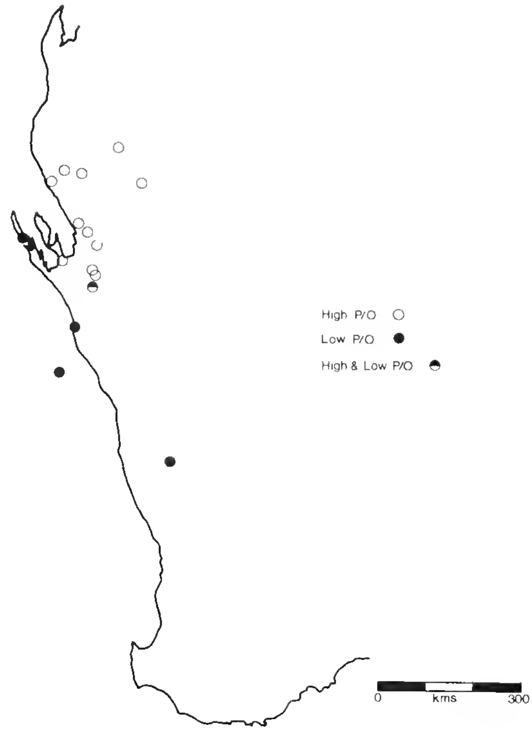

Fig. 3. Distribution of inbreeding (closed circles) and outbreeding (open circles) populations of *Actinobole condensatum* in Western Australia.

tains some individuals with high P/O's and others with low P/O's (fig. 3). P/O differences are correlated with changes in anther size but apart from this character no other differences are apparent between outbreeding and inbreeding individuals.

The distribution pattern observed within *A.condensatum* is reminiscent of patterns frequently displayed by diploid and tetraploid individuals. To date only a single chromosome count for the species, n = 10, has been recorded (Turner, 1970). Turner's voucher collection, (*T5388*), contains specimens with high P/O's.

Angianthus Wendl.

Fifteen species are recognized within this genus (Short, in press). The majority of species have pentamerous florets but *A.preissianus* Steetz, with an average P/O of 119.7, has trimerous and tetramerous florets. Two species, *A.pygmaeus* (A. Gray) Benth and *A.drummondii* (Turcz.) Benth. (including specimens referred to *A.*sp.aff.*drummondii,* Short, in press) must be regarded as close relatives of *A.preissianus. A.drummondii* is an uncommon species and P/O data are unavailable. However, like *A. pygmaeus,* (with an average P/O of 2,345.4), the species contains pentamerous florets and from the few individuals examined, it appears that it too has a P/O of several thousand.

Both *A.pygmaeus* and *A.drummondii* are restricted to the south-west of Western Australia. The former species is restricted to saline depressions of the Avon River System (Bettenay and Mulcahy, 1972) between latitudes c.31°30′S and 33°30′S and longitudes c.117°00′E and 120°00′E. The only known specimens of *A.drummondii* are from the vicinity of the Tone, Hotham, Harvey and Preston Rivers. Specimens referred to as *A.*sp.aff.*drummondii* appear, like *A.pygmaeus,* to favour saline locations, most collections being from the Lake King-Lake Grace region of Western Australia. In contrast the inbreeding *A.preissianus* grows around salt lakes and along much of the coastline of southern mainland Australia and northern Tasmania (fig. 2).

Apart from differences in floret lobe number and anther sac size there is nothing to indicate the differences in breeding systems exhibited by *A.preissianus* and the related *A.pygmaeus* and *A.drummondii.*

Unlike the above-mentioned species of *Angianthus,* the remaining ones tend to produce large, showy compound heads and appear to have P/O's of one to several thousand. Some of the species, e.g. *A.acrohyalinus, A.milnei* and *A.tomentosus,* which are capable of producing compound heads containing perhaps 500 to c.2,000 two-flowered capitula, produce relatively few seeds under natural conditions. Thus even *A.tomentosus,*a species known to be self-compatible (G. J. Keighery, unpublished data), may only set c.100 seeds per compound head. The low actual: potential seed set ratio may be a reflection of selection for maintenance of a showy inflorescence, the prime purpose of which is to attract pollinators. In contrast to the outbreeders *A.preissianus* appears, as expected, to produce a full complement of apparently mature, viable seed.

Many species of *Angianthus* are endemic to, and have moderately restricted distributions in, Western Australia while species occuring in central and eastern Australia tend to be distributed over a much greater area of the continent (Short, in press). It is also noteworthy that eleven of the fifteen species often grow on the margin of salt lakes, with perhaps five or six being confined to such habitats. Several of these, including the only perennial species, *A.cunninghamii,* also occur in coastal situations.

Blennospora A. Gray

The genus *Blennospora* is considered here to contain 2 species, *B.drummondii* A. Gray and *B.phlegmatocarpa* (Diels) Short. These species, normally referred to *Calocephalus* R.Br., can be readily distinguished from that genus by a number of characters, i.e. pappus type, morphology and arrangement of bracts and cypsela morphology. *Calocephalus stowardii* Moore is considered to be conspecific with *B.phlegmatocarpa.*

Blennospora phlegmatocarpa, with an average P/O of 4,119.7, may be readily distinguished from its inbreeding relative, *B.drummondii,* (with an average P/O of 231), by its bright yellow, pentamerous florets and the presence of a strong, almost putrid odour. The latter species has brown pentamerous and occasionally tetramerous florets which emit a comparatively weak odour. Both species have a haploid chromosome number of 11.

Observations of style position at the time of dehiscence suggest that *B.phlegmatocarpa* is protandrous. In mature florets the style is exserted c.0.5-0.8 mm above the reflexed corolla lobes. However anthesis occurs well before the apparently immature style is exserted and indeed the majority of pollen is shed on the style as it grows between the anthers. The style arms remain straight as they pass between the anthers but reflex when growth stops. The high P/O and strong scent of the florets also suggests that the species is protandrous. This would be consistent with results obtained by Cruden (1977) for xenogamous species. Cruden (l.c.) also noted that the xenogamous species he examined were self-incompatible. This has not been checked in *B.phlegmatocarpa* but the recurved nature of the style arms suggests that in the event that cross-pollination does not occur the species may self-pollinate, some pollen always remaining in the floret after anthesis.

In *B.drummondii* recurved style arms are exserted above the corolla at anthesis but never as prominently as in *B.phlegmatocarpa.* The low P/O and the position of the style arms at anthesis suggest that the species is protogynous. This mechanism, despite the low number of pollen grains produced, would enable some outcrossing to occur. The species is self-compatible with most, if not all, florets appearing to produce mature, viable seed when pollinators are excluded.

Blennospora phlegmatocarpa is almost invariably restricted to the saline, often sandy, soils on the margins of salt lakes of the Avon River System (Bettenay & Mulcahy, 1972) between latitudes c.31°S and c.33°S and longitudes 116°E and

119°E (fig. 2). It is commonly associated with genera such as *Halosarcia, Atriplex* and *Disphyma,* all of which tend to grow in the innermost vegetation zone of salt lakes but occasionally individuals may be found in an outer *Melaleuca* zone. Although primarily restricted to salt lakes one collection (*Short 654*) has been made from *Eucalyptus* woodland near Bruce Rock and another (*Short 658*) from the base of granite rocks at Roe Dam.

Blennospora drummondii is a widespread species occurring in the south-west of Western Australia, southern South Australia and western Victoria (fig. 2). It undoubtedly has a much lower tolerance to salinity than *B.phlegmatocarpa* with only a few collections coming from the *Melaleuca* zone of salt lakes. Many collections of this species come from moss swards at the base of granite outcrops but it may be found in a range of woodland or mallee communities. The 2 species have never been found growing together.

Chrysocoryne Endl.

This genus contains 6 species, namely *C.pusilla* (Benth.) Endl., *C.uniflora* Turcz. and *C.drummondii* A. Gray plus 3 new species, here referred to as *Chrysocoryne* spp. A, B and C. Three of the species are outbreeders while the remainder are inbreeders (table 1, fig. 1). All occur in the south-west of Western Australia (fig. 4), with only *C.pusilla* and *C.drummondii* extending beyond that state.

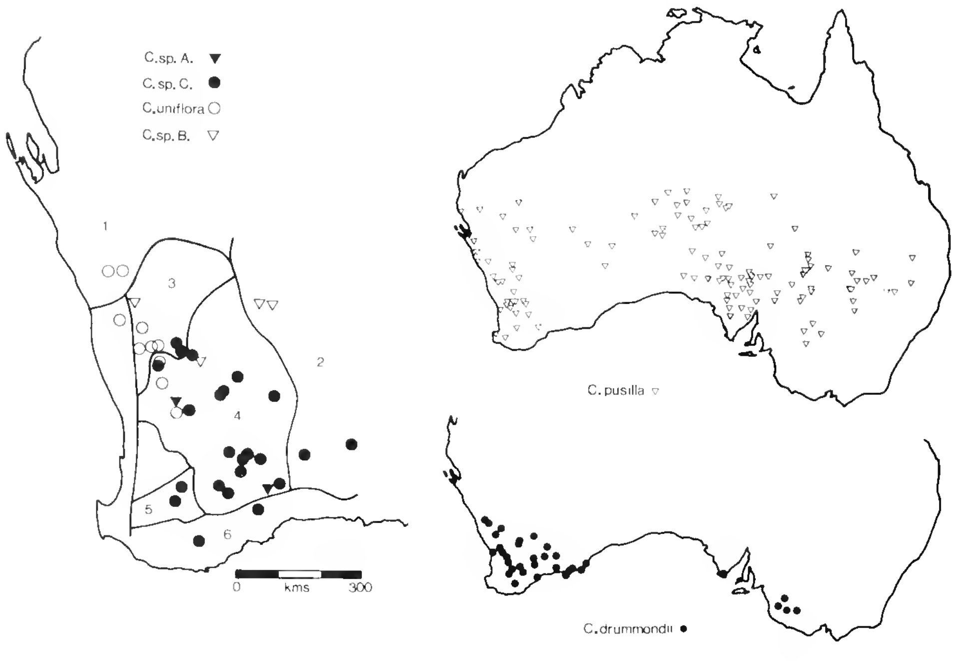

Fig. 4. Distribution of species of *Chrysocoryne*. Outbreeding species with open symbols, inbreeding species with solid symbols.
Drainage basins in Western Australia:
1. Murchison Division
2. Eucla Division
3. Monger System
4. Avon System
5. Blackwood System
6. South Coast System

Members of the genus are very closely related with differences occurring in the number of lobes per floret (inbreeders have predominantly, or entirely, tri- and tetramerous florets), the number of florets per capitulum, the number of capitular bracts per capitulum and the number of capitula per species. Differences in habit, bract morphology and chromosome numbers also occur and a tentative phylogeny has been constructed (Short, unpublished data). The outbreeding *C.pusilla* (average P/O = 1,967), a self-compatible species (G. J. Keighery, unpublished data), must be regarded as the species with the most primitive characteristics. Furthermore its distribution pattern contrasts with that observed in most other species examined in that it is an outbreeder widespread across much of Australia. Unlike the other species of *Chrysocoryne* it is also quite polymorphic. It frequents a wide range of habitats, commonly growing on the margins of saline depressions, on coastal dunes, in moss swards around granite outcrops, in chenopod steppe, or on *Triodia* dominated red sand-dunes of the inland.

The only other widespread species, the inbreeding *C.drummondii* (average P/O = 121.9), is generally morphologically uniform and occupies a number of habitats. In Western Australia it is confined to the south-west of the state, commonly occurring on the margins of salt lakes and at the base of granite outcrops. A few isolated populations occur on southern Eyre Peninsula, South Australia, while it is also common in a small region of south-eastern South Australia and central-western Victoria.

The remaining species, *C.uniflora* (average P/O = 1,777.5), B (average P/O = 2,043.6), A (average P/O = 105.8) and C (average P/O = 48.6), are restricted to salt lakes of Western Australia. Thus all species of *Chrysocoryne* may be encountered on the margins of saline depressions and indeed 2 or more commonly occur in the same locality. For example, all except species B have been collected from the saline Mortlock River flats near Meckering.

Specific differences are presumably maintained by a number of parameters, including differences in habitat, chromosome number and flowering time. Indeed *C.pusilla* is rarely observed growing amongst samphire, the common habitat of the other species, and tentative chromosome counts of n = 6, 12 and c.13 have been obtained for *C.pusilla* and species A and C respectively. Similarly field observations suggest that species C reaches maturity some days before the closely related *C.uniflora* with which it commonly grows. These factors, when combined with the inbreeding nature of 3 of the species, present a formidable barrier to interspecific crossing. No evidence of hybridization has been found between any species.

Mulcahy and Bettenay (1972) recognized 6 drainage divisions within Western Australia, and all species of *Chrysocoryne* occur within the South West Division. Both *C.pusilla* and *C.drummondii* are of course found both within and extensively outside the division. *Chrysocoryne uniflora* and species B and C are most common within the region while species A is in fact confined within its boundaries (fig. 4). A number of palaeo-drainage systems associated with the chains of salt lakes in the region may also be recognised within the division (Bettenay and Mulcahy, 1972). Species A is confined to the Avon System (fig. 4), the only collections coming from Lake King and the Mortlock River flats near Meckering. Although several collections come from both the southern edge of the Murchison Division and from the northern half of the Avon System, *C.uniflora* is undoubtedly most common in the Monger System. Species B, although extending into the Eucla Division where collections have been made from Lake Barlee, appears to be otherwise restricted to the upper half of the South West Division, single collections coming from the Monger and Avon Systems. Species C barely extends into the Monger System, being most common in the Avon, Blackwood and South Coast Systems. It has also been collected from two salt lakes in the south-west of the Eucla Division.

Thus it appears that the major drainage divisions and their constituent systems have influenced the distribution of species of *Chrysocoryne*. The occurrence of a species in more than one system is probably a reflection of the fact that seed disper-

sal, presumably by wind, is not inhibited by any substantial barriers, such as ranges of hills, between them.

The occurrence of all species on salt lakes is also reflected by the fact that they all possess scale-like glandular hairs on their stems and leaves, such hairs being characteristic of many plants growing in saline conditions. A few such hairs are always to be found on *C.pusilla* and *C.drummondii,* even when growing in non-saline habitats. This condition, plus their current distribution, strongly suggests evolution of the group in a saline environment.

Chthonocephalus Steetz

This genus consists of perhaps 5 species, 3 of which are undescribed. Four of the species produce uniformly pentamerous florets while one, *C. pseudevax* Steetz has trimerous and tetramerous florets, an average P/O of 150.7, and is widespread across much of Australia, occurring between latitudes c.25°S and c.36°S and west of longitude c.148°E (fig. 2). It occupies a variety of habitats, commonly occurring in sandy depressions on granite outcrops or in sandy soil amongst *Halosarcia* and *Melaleuca* plants on the edge of saline depressions. The species is undoubtedly closely related to an undescribed, outbreeding species (average P/O = 1,539), here referred to as *C.*sp.aff.*pseudevax*. This taxon is known from a single collection (*Short 394*) coming from *Acacia linophylla*-dominated red sand-dunes c.100 km N. of the Murchison River Bridge on the North West Coastal Highway, Western Australia. Like *C.pseudevax* it is a dwarf, stemless plant, each plant having a single compound head, c.1-2 cm in diameter, surrounded by an involucre of leaves. The 2 species may be readily distinguished on leaf shape but *C.*sp.aff.*pseudevax,* because of its pentamerous florets, also has a much more conspicuous inflorescence than *C.pseudevax.*

Observations suggest that the 3 remaining species are predominantly outbreeders with P/O's of several thousand. Two of the species (*C.tomentellus* (F.Muell.) Benth. and *C.*sp.aff.*tomentellus* sp.nov.) are restricted to the Shark Bay region of Western Australia which contains all *Chthoncephalus* species and is the centre of diversity of the genus. The remaining species (undescribed) extends through much of central Western Australia and into the north-west of South Australia and the south-west of the Northern Territory.

Pogonolepis Steetz

This genus contains a number of, as yet somewhat ill-defined, closely related outbreeding and inbreeding taxa. The genus has its centre of diversity in the south-west of Western Australia, where perhaps 6 taxa, all endemic, occur. A single species, *P.muellerana* (Sond.) Short, occurs in southern South Australia, southern New South Wales and Victoria. All taxa have pentamerous florets and their general apearance gives no reason to suspect the vast differences in P/O's obtained.

Three or four outbreeding taxa, including *P.stricta* (average P/O = 3,185.4) and *Pogonolepis* sp. A (Average P/O = 3,761.4), occur in Western Australia. To date accurate P/O's have not been determined but it is apparent that at least 2 inbreeding taxa also occur in that state, one taxon having only been collected from Eclipse Lake (*Chinnock 4357*). The remaining inbreeder, which appears to have close affinities with *P. muellerana,* is more widespread in southern Western Australia.

With the exception of *P.stricta,* which appears to be restricted to saline flats of Leschenault Inlet and the Vasse Estuary, all Western Australian taxa appear to occur on the margins of salt lakes and indeed several appear to be restricted to such habitats. The widespread *P.muellerana* (average P/O = 227.2) occupies a variety of habitats. It is extremely common amongst *Halosarcia* and other chenopods on the edge of both coastal and inland saline flats but is also common in a variety of mallee habitats.

Chromosome numbers promise to provide useful information in this genus. Counts of n = 4, 5 and 6 have been obtained for outbreeding taxa, while counts of

n = 7, c.10 and c.12 have been obtained for inbreeding taxa. The high numbers (i.e. c.10 and 12) obtained for the presumably derived inbreeders suggests that at least two taxa are of polyploid origin.

Millotia Cass.

Schodde (1963, 1968) recognized 5 species of *Millotia.* Two species, *M.macrocarpa* Schodde and *M.tenuifolia* Cass. were found to possess trimerous and tetramerous florets while the remaining three, *M.myosotidifolia* (Benth.) Steetz, *M.greevesii* F. Muell, and *M.inopinata* Schodde have pentamerous florets. It was also found that the terminal anther appendages of the species with pentamerous florets were more or less exserted from the corolla tube at anthesis. In contrast the anthers of the other species were enclosed, or at least barely exposed, at anthesis. Such differences suggested to the present author that quite different breeding systems were likely to be found between species. Although adequate material was unavailable for detailed determinations of P/O's in all species, low P/O's occur in both *M.macrocarpa* and *M.tenuifolia,* an average P/O of 154.9 being recorded for the latter species. The remaining species appear to have P/O's of several thousand.

Of the inbreeders, *M.tenuifolia* is widespread across much of the southern Australian mainland and extends to Tasmania while *M.macrocarpa* occurs in semi-arid South Australia and north-western Victoria (Schodde, 1963). In contrast to the frequently observed patterns of distribution in related outbreeding and inbreeding species both *M.myosotidifolia* and *M.greevesii* are also widespread across much of Australia. On the other hand *M.inopinata* is restricted to more or less central Western Australia (Schodde, 1968).

Siloxerus Labill.

The members of this genus, *S.humifusus* Labill, *S.filifolius* (Benth.) Ostenf. and *S.pygmaeus* (A. Gray) Short are restricted to the south-west of Western Australia. Florets of the latter species are trimerous or tetramerous while both *S.humifusus* and *S.filifolius* have tetramerous and pentamerous florets. Good material for accurate P/O determinations was not available, but the few anthers examined suggest low P/O's (c.200) for all species. A single specimen of *S.humifusus* (*Short 1055*) was found to have a P/O of 168.

Siloxerus humifusus is primarily distinguishable from *S.filifolius* on differences in the size of various organs, the cypselas, capitular bracts, pappus bristles and florets of *S.humifusus* being approximately twice the length of the same characters in the latter species. Such features suggest that *S.humifusus* may be of polyploid origin.

Siloxerus humifusus and *S.filifolius* occur in a variety of habitats, e.g. open *Eucalyptus—Xanthorrhoea* woodland or at the base of granite outcrops, and frequently occur together (fig. 5). On the other hand *S.pygmaeus,* occurring to the east and north of the other species, appears to grow almost exclusively on the margins of salt lakes of, mainly, the Avon System and the south-western section of the Eucla Division (Bettenay & Mulcahy, l.c.)

Rutidosis DC.

Usually nine or ten species are included in this genus (Burbidge, 1963). A variety of characters, particularly of the cypsela, suggest that one, *R.multiflora* (Nees) Robinson, is generically distinct from the others. It possesses trimerous and tetramerous florets, has an average P/O of 33.4, and is widespread, occurring in Tasmania and across much of southern Australia.

Toxanthes Turcz.

Both species of this genus, *T.perpusilla* Turcz. and *T.muelleri* (Sond.) Benth., are widespread across southern Australia and usually have a mixture of trimerous, tetramerous and pentamerous florets in their capitula. The plants are small (several

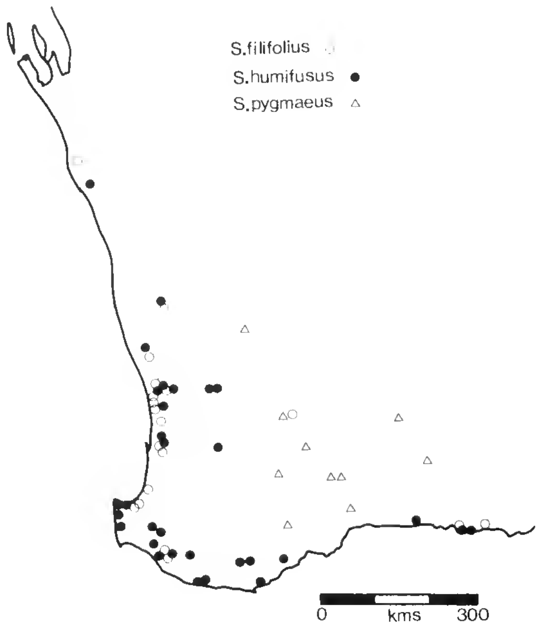

Fig. 5. Distribution of *Siloxerus* species in Western Australia.

cm high) and produce more or less inconspicuous capitula. P/O's have not been determined for *T.perpusilla* but, like *T.muelleri* (average P/O = 83.5), it should prove to be an inbreeding species.

The average P/O's of two other hermaphroditic species with tetramerous florets, **Myriocephalus rhizocephalus* (DC.) Benth. (average P/O = 107.6) and *Helipterum demissum* (A. Gray) Druce (average P/O = 84.6) have also been determined. Both species are inbreeders and are widespread across southern Australia, with *H.demissum* reaching Tasmania. Both *Myriocephalus* Benth. and *Helipterum* DC. are seriously in need of revision and no attempt has been made to determine the affinities of either species.

Gynomonoecious *Helichrysum tepperi* F.Muell. and andromonoecious *Helipterum pygmaeum* (DC.) Benth. are small, generally inconspicuous annuals and are widespread across southern Australia. *Helichrysum tepperi,* with an average P/O of 37.5, has a ratio of approximately 1 female to 1 bisexual floret. Both floret types are trimerous and tetramerous. *Helipterum pygmaeum,* with an averge P/O of 252, produces from 3 to 5 florets per capitulum and has a ratio of approximately 1 male to 2 bisexual florets. The latter florets are tetra- or pentamerous while the male florets, the last formed, are tri-, tetra- or pentamerous. All florets produce approximately the same number of pollen grains.

DISCUSSION

Pollen-Ovule Ratios

As previously stated, Cruden (1977) has shown that P/O's are a conservative indicator of a flowering plant's breeding system, this conclusion also being supported in a number of other publications. Various factors can however result in a plant having a lower P/O than would normally be expected. For example a number of plants with clumped pollen, pollinia or polyads as in the Onagraceae, Asclepidaceae and Mimosaceae have much lower P/O's than those suggested by their apparent out-

**M.isoetes* Diels is probably conspecific.

crossing attributes (Cruden, 1977; Cruden & Jensen, 1979). A further factor, asexual reproduction, may also be correlated with unexpectedly low P/O values in some plants. Thus in *Wurmbea dioica* (R.Br.) F. Muell. a polygamo-dioecious species of the Liliaceae which must usually, if not always, cross-pollinate, a seemingly low P/O of 818 (Short, unpublished data) may well be a reflection of this taxon's ability to produce bulbs.

However, despite the occasional exception there seems little doubt that P/O's do reflect a plant's breeding system. Indeed in the Gnaphaliinae examined very different P/O's were obtained for related species with obviously different morphological attributes which in themselves suggested different breeding systems, e.g. differences in bract size in *Actinobole condensatum* and *A.uliginosum.* Furthermore P/O's have also been very useful for distinguishing taxa almost unrecognizable by macro-morphological characters but with apparently distinctly different breeding systems from related taxa. Such examples are found in the various taxa of *Pogonolepis* and within *Actinobole condensatum*. In the latter species differences in P/O's obtained within a single population (*Short 393*) underline the importance of sampling individual plants within a population rather than obtaining a value from a mass sampling technique involving the lumping together of florets and/or anthers of more than one individual

Few samples exist in the literature in which P/O's for a number of populations of a species have been determined. Where this has been the case the populations usually exhibit distinctly different P/O's which are reflected by various morphological characters and/or reproductive parameters such as pollinator activity and nectar production e.g. *Hedeoma hispida, Caesalpinia pulcherrimma* (Cruden, 1976; Cruden & Hermman-Parker, 1979) and *Gilia achilleifolia* (Schoen, 1977). In the data presented (table 1, appendix II) it is therefore significant that, with the exception of *Actinobole condensatum,* in cases where 3 or more apparently macro-morphologically similar populations were examined the P/O's were similar despite the large geographical range over which some species were sampled. That is, all populations of a species are readily referrable to either a generalized inbreeding or outbreeding class.

On the other hand statistically different average P/O's occur between populations of many species (appendix II). For example in *Actinobole uliginosum* the average P/O's of the populations *Barker 2646* and *Short 377* are significantly different ($p = 0.001$) from the remaining populations of the species. In yet another case significantly different values were obtained in *Pogonolepis muellerana* where P/O values were determined for the same population in consecutive years (*Short 821, Short 870*, $t = 4.07$, $p = 0.001$). Given that the results reflect a true picture of P/O values then are the differences biologically significant?

Gene flow via pollen grain dispersal is influenced by parameters such as pollinator type and activity and the spacing of individual plants. Such factors make it difficult to draw any conclusions as to the significance of the P/O differences between populations. However it is worth recalling that even low levels of outcrossing may greatly affect the level of heterozygosity in a population. For example, although hybrid advantage probably influenced results, it is clear from experiments such as Allard's (1965) on lima beans that even a level of 5% outcrossing can greatly influence population structure. Furthermore Allard (l.c.) recorded that the degree of outcrossing in populations of wild oats may vary from c.1% to 10% and suggested that the degree of outcrossing is subject to ready adjustment. Perhaps then seemingly minor differences in pollen production reflect different degrees of recombination in populations.

The low P/O's of andromonoecious *Helipterum pygmaeum* (37.5) and gynomonoecious *Helichrysum tepperi* (252) suggest that both species must be basically inbreeders. The low value obtained for *H.tepperi* suggests that female florets usually receive pollen from bisexual florets within the same capitulum. Perhaps female florets are retained because they are one way of enhancing occa-

sional, possibly beneficial, outcrossing. Such a situation has been suggested for inbreeding species of *Lasthenia* (Ornduff, 1966).

It is difficult to comment on the significance of andromonoecy in *H.pygmaeum*. At this stage the relationship of the species is not clear. If derived from an hermaphroditic, self-compatible taxon then it would seem reasonable to assume that the andromonoecious condition is, as commonly suggested, a result of selection for a greater degree of outcrossing. On the other hand Willson (1979) has recently suggested that andromonoecy may be a result of sexual selection, that is that an increase in pollen grain production leads to greater competition between grains to effect fertilization. Whatever the reason for selection further investigation of the breeding systems of *H.pygmaeum* and related taxa is desirable. The P/O value cited was obtained for a single population containing individuals which lack laminae on the capitula bracts and are referrable to *H.pygmaeum* var. *occidentale* Benth. Other populations are comprised of individuals with more conspicuous capitula, the bracts possessing white laminae c.1-2 mm long.

Evolution, Causes and Consequences of Inbreeding

There is little doubt that inbreeding is generally a derived condition, the evolution of autogamous taxa from predominantly outcrossing taxa being well documented in a large number of families, e.g. *Gilia* (Polemoniaceae: Grant & Grant, 1965, Schoen, 1977), *Leavenworthia* (Cruciferae: Loyd, 1965), *Limnanthes* (Limnanthaceae: Ornduff & Crovello, 1968; Arroyo, 1973) and members of the Onagraceae (Moore and Lewis, 1965; Raven, 1979). Examples within the Compositae include the tribe Cichorieae (= Lactuceae) (Stebbins, 1958), *Lasthenia* (Heliantheae: Ornduff, 1965) and *Eupatorium* (Eupatorieae: Baker 1967). Various attributes of plants support this conclusion (see Stebbins, 1957). For example self-fertilizing taxa often have more specialised morphological characteristics than their outbreeding relative. Furthermore some inbreeders may possess attributes which are of use only in outbreeders e.g. floral markings and non-functional nectaries. Among the other things Stebbins (1957) has also referred to the fact that there are documented records of self-fertilizing populations orginating in recent times. This appears to be the case in *Primula vulgaris* and *Antirrhinum majus.*

Ornduff (1969), when discussing the relationships of reproductive biology to systematics, outlined many character differences which are commonly related to changes from outbreeding to inbreeding. Many such differences, e.g. narrow vs wide distribution, self-incompatibility vs self-compatibility and diploidy vs polyploidy, were observed in a number of Gnaphaliinae (table 2) and generally require no further comment. It is, however, noteworthy that all species with tri- and/or tetramerous disc florets, including those with no apparent outbreeding relative, are inbreeders. Gardner (1977) has pointed out that approximately 80 genera of Compositae contain species with such florets. He suggested that such a change was related to either selective pressure for increased seed production or, as supported here, a change from chasmogamy to autogamy. In some species studies there may well be a correlation of tri- and/or tetramerous florets with an increase in the number of florets and therefore seeds per unit area of receptacle but this factor has not been closely examined.

Possible reasons for selection of inbreeding have been outlined by a number of authors and the various ideas, not necessarily mutually exclusive, have been reviewed by Jain (1976). It has for example commonly been argued (e.g. Grant, 1958; Stebbins, 1958) that inbreeding may be favoured when, under certain environmental conditions, it is advantageous to lower the rate of recombination, thus producing more or less genetically uniform individuals. Other hypotheses include the suggestion that selfing is a mechanism by which a beneficial structural rearrangement in chromosomes may be isolated or is a way in which reproduction may be assured under certain conditions such as a lack of, or compeititon for pollinators.

Lloyd (1979 a, b) has suggested that there has in fact been over emphasis on the importance of selection for genetic recombination, suggesting instead that factors such as assured reproduction, retrieval of meiotic cost and easier colonization are of greater importance.

While a discussion of the various hypotheses is beyond the scope of this paper the possible importance of pollinator availability is of interest. Arroyo (1972) suggested that autogamy has arisen in *Limnanthes floccosa* as a result of a combination of effects. Thus in the related outcrossing *L.alba,* which sets little seed in the absence of pollinators, the degree to which the species can penetrate into arid regions is dependent on seed production and germination. In exceptionally dry seasons population size is reduced, plants stunted and pollinators scarce or absent. Even following successful pollination ovules often fail to develop because of water stress. On the other hand populations of *L.floccosa* spp. *californica,* which inhabit the same areas as *L.alba,* are little affected by seasonal variation. Because this taxon is autogamous it is not dependent on pollinator activity for high seed set. Furthermore the plants flower much earlier than their outbreeding counterparts, thus enabling ovules to mature before the soil becomes too dry.

In the Gnaphaliinae studied the limited data indicate that some, if not all, of the outbreeding species are self-compatible but the degree of seed set in the absence of pollinators is unknown. Nonetheless a scheme such as that outlined for *Limnanthes* may well explain the selection for a greater degree of selfing in some taxa. On the other hand preliminary observations suggest that none of the species are adapted to specific pollinators, with flies, bees and ants possibly being responsible for the bulk of cross-pollination. In dry seasons the non-dependence on specific pollinators may be an important factor for ensuring pollination. A non-dependence on pollinators is also supported by the fact that outbreeding species of *Angianthus,* plus outbreeders such as *Actinobole condensatum, Chrysocoryne pussilla, C.uniflora, Chrysocoryne* sp. B, *Chthonocephalus* sp.aff. *pseudevax* and other outbreeding species of *Chthonocephalus* commonly occur in as dry or drier regions than their inbreeding counterparts.

Even if pollinator activity has not been an important factor in selection for inbreeding it is nevertheless likely that reproductive assurance has influenced its selection. Indeed, as mentioned above, *Chrysocoryne* sp.C. exhibits both a greater degree of inbreeding and as indicated by field evidence and habit differences, a shorter life cycle than the closely related outbreeder, *C.uniflora.* Although both species inhabit similar environments a greater degree of aridity in the past may well have favoured selection of inbreeding variants with shorter life cycles. Workers such as Solbrig (1976) and Cruden (1977) have suggested that in autogamous species there is a reduction in the amount of energy required for the development of each flower. Waller (1979) has in fact found that cleistogamous flowers of *Impatiens capensis* produce ripe seed in c.24 days compared to c.36 days for chasmogamous flowers. Furthermore it costs about 1.5 to 2 times as much energy, material and time resources to produce outcrossed as opposed to selfed seeds. Thus it would come as no surprise if other inbreeding *Gnaphaliinae* examined were to be found to have a significantly shorter life cycle than their outbreeding counterparts, presumably less energy being required to produce the smaller number of lobes per floret, anthers and/or pollen grains found in these taxa.

The various factors which regulate recombination rates have been thoroughly discussed by Grant (1958) and similarly the genetic consequences have been examined by a large number of workers (e.g. Allard, 1965; Allard et al., 1968; Jain, 1976) and need not be critically discussed. Theoretically inbreeders should be much more homozygous than their outbreeding relatives. However studies have shown that successful inbreeders have extremely flexible genetic systems. On the one hand highly adapted genotypes may be produced to occupy the various microenvironmental niches occupied by a population while on the other the species maintains the ability to adjust to long term changes in the environment. This is in contrast to an

outbreeding species which lacks the ability to perpetuate a highly adapted genotype (Allard, 1965). The distribution of many of the inbreeding species examined across much of the Australian mainland, plus their frequent occurrence in diverse habitats, is perhaps a reflection of this ability. However it should be stressed that inbreeding is of course not a pre-requisite for the successful spread of a species. For example *Chrysocoryne pusilla, Millotia myosotidifolia, M. greevesii* and some species of *Angianthus* are wide-spread outbreeders. Chromosome number, the possible non-reliance on pollinators and self-compatibility are some factors which may account for their success.

Distribution Patterns

Given that inbreeding is a derived characteristic the distribution pattern of closely related outbreeders and inbreeders can, like the distribution patterns exhibited by diploid and polyploid entities, provide a clue as to the centre of origin and direction of spread of taxa. In *Actinobole, Blennospora, Chthonocephalus* and the *Angianthus pygmaeus/A.drummondii/A.preissianus* group it is tempting to suggest that the inbreeding taxa have been directly derived from their outbreeding relatives. If this is so then it would appear that in all cases, even allowing for some geographical replacement of the outbreeder by the inbreeder, the inbreeding taxa have presumably originated somewhere in Western Australia and subsequently spread to the east.

Disjunct distributions are well known for many species, both plant and animal. For example Green (1964) has cited 35 autochthonous species of flowering plants with marked disjunctions between south-western and south-eastern Australia. Similarly he noted that perhaps c.50 vicarious species pairs of plants existed between the two regions. Most certainly *Chrysocoryne drummondii* is a good example of a species with a disjunct distribution. This species, like *Pogonolepis muellerana* which only appears to occur in the eastern states, has undoubtedly arisen from an ancestral taxon in Western Australia. Detailed distribution maps have not been compiled for species such as *Helichrysum tepperi, Helipterum demissum, Helipterum pygmaeum, Rutidosis multiflora* and *Toxanthes muelleri* but some, if not all, will probably be found to have their otherwise continuous distribution across Australia disrupted in the Nullarbor Plain region.

As pointed out by Green (l.c.) the observed plant disjunctions are unlikely to be the result of a single separation of eastern and western Australia by say the Miocene inundation of the Nullarbor Plain or alternatively late Pleistocene changes. He also pointed out that some disjunctions may well be the result of long-distance dispersal. Several of the species do possess plumose pappus structures which may aid in wind dispersal. Still others frequently occur in saline conditions which suggest that propagules may well tolerate prolonged immersion in sea water. Most certainly *Angianthus preissianus* is likely to be dispersed by sea. Its apparent absence from the coastline of the Great Australian Bight (fig. 2) may indeed be a reflection of a lack of suitable habitats and/or inadequate collecting in this region. Providing suitable habitats are available then the fact that the above mentioned species are inbreeders also enhances the likelihood of their successful colonization after long distance dispersal, a single plant being capable of establishing a new colony (Baker, 1955).

Many of the species belonging to *Angianthus, Blennospora, Chrysocoryne, Pogonolepis* and other genera examined commonly occur around the margins of salt lakes. Indeed, particularly in *Chrysocoryne,* it would seem that, as well as influencing distribution patterns, the lake systems of south-west Western Australia have been reservoirs for speciation. In this region it is easy to envisage the isolation of populations not only between systems but presumably with any lake system as well. Even today lakes within a system may be isolated for a number of years with water only linking them in exceptionally wet years. For example Bettenay (1962) has traced water movement from Lake Brown to Quairading (Avon System), a distance of approximately 160 km. The very close relationship of the various species of

Chrysocoryne suggests that some have evolved in quite recent times. Perhaps the wet-dry oscillations of the past 100,000 years (Bowler, 1980) would provide for the isolation of individual lakes and therefore populations, within any one system. Such oscillations have probably also played an important part in the origin of the inbreeding taxa of *Actinobole, Chthonocephalus, Pogonolepis* and other genera and may possibly explain the disjunct distributions of many species.

Finally it is of interest to note that Burbidge (1960) suggested that extensive colonization of the arid zone may have occurred from strand habitats. This may well have been the case for the various species of *Angianthus, Chrysocoryne* and *Pogonolepis,* all of which contain species occurring in coastal habitats as well as the arid zone. On the other hand, as mentioned above, the genera also contain species commonly found on and often restricted to, the margins of salt lakes. Such distribution patterns do in fact raise the question of whether or not salinity tolerant, ancestral taxa of extant species arose in inland salt lake systems instead of strand habitats. That is, have inland salt lakes also been important reservoirs from which colonization of the arid zone has occurred? At least in *Chrysocoryne* the relationships of the species and their current distribution patterns suggest that such a hypothesis is as equally tenable as a hypothesis suggesting evolution and migration from a strand habitat.

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APPENDIX 1

New Combinations in the Australian Gnaphaliinae

Actinobole condensatum (A. Gray) Short, comb. nov.
Basionym: *Gnaphalodes condensatum* A. Gray, *Hook. J. Bot. Kew Gard. Misc.* 4: 228 (1852).

As pointed out by Eichler (1963) the generic name *Gnaphalodes* A. Gray (1852, l.c.) is illegitimate, as it is a later homonym of *Gnaphalodes* Miller (1754). Thus he made a new combination for the species *G.uliginosum,* making the latter the neotype species of *Actinobole* Fenzl ex Endl.

Blennospora phlegmatocarpa (Diels) Short, comb. nov.
Basionym: *Calocephalus phlegmatocarpus* Diels, *Bot. Jb.* 35: 614 (1905).

Pogonolepis muellerana (Sond.) Short, comb. nov.
Basionym: *Skirrhophorus muelleranus* Sond., *Linnaea* 25: 486 (1853) ('*Muellerianus)*'.

Siloxerus pygmaeus (A. Gray) Short, comb. nov.
Basionym: *Chamaesphaerion pygmaeum* A. Gray. *Hook, J. Bot. Kew Gard. Misc.* 3: 177 (1851).

APPENDIX 2

Pollen-ovule ratios of individual populations of species of Gnaphaliinae
(n = number of individuals)

Species	Population	Pollen-ovule ratio: Mean	± Standard Deviation	± Standard Error	n
Actinobole condensatum	*Short 380* Red Bluff, W.A. 27°45′S, 114°09′E.	373.6	77.5	20	15
	Short 393 c.100km N. of Murchison River bridge on north-west coastal highway, W.A. c.27°00′S, 114°38′E.	370.3	20.7	12	3
		1,889.8	268.1	77.4	12
	Short 417 c.28km S. of Overlander Roadhouse on north-west coastal highway, W.A. 26°38′S, 114°33′E.	2,155.5	383.5	99	15
	Collections classified as outbreeding or inbreeding on the basis of single P/O values and/or anther size: Outbreeders—*Blackall 4695; Burbidge 6464, 6483; Gardner 6038, 6062a, s.n.; Short 4141, 437, 453; Turner 5388.* Inbreeders—*George 11409; Royce 9680; Storr s.n.*				
Actinobole uliginosum	*Short 352* c.10km from Three Springs on main Morowa road, W.A. 29°28′S, 115°44′E.	112.5	18.1	4.6	15
	Short 377 c.23km N. of Geraldton on main Northampton road, W.A. c.28°32′S, 114°39′E.	88.5	11.0	2.8	15
	Short 755 c.31.6km E. of Leigh Creek homestead on road to Balcanoona, S.A. c.30°31′S, 138°41′E.	121.8	23.0	5.9	15
	Short 779 Podinna Rock, S.A. 32°41′S, 135°11′E.	127.4	18.9	4.8	15
	Short 864 c.6km SW of Pt. Julia, S.A. 34°42′S, 137°49′E.	122.6	12.1	3.1	15
	Barker 2646 c.64km N. of Tibooburra, Q. 28°56′S, 141°54′30″E.	75.6	18.7	5.6	11
	Short 872 c.4.5km NW of Dimboola, V. 36°26′S, 142°00′E.	117.6	13.2	3.4	15
Angianthus pygmaeus	*Short 617* 3.4km E. of Meckering in Mortlock River flats, W.A. 31°37′S, 117°02′E.	2,345.4	330.3	85.2	15
Angianthus preissianus	*Short 1013* c.14km from Jurien Bay along main road to Badgingarra, W.A. c.30°16′S, 115°07′E.	164.6	28.9	7.4	15
	Short 800 c.10km S. of Streaky Bay on main road to Sceale Bay, S.A. 32°53′S, 134°12′E.	125	19.1	4.9	15
	Short 814 c.7km NE of Wangary on road to Edillilie, S.A. 34°30′S, 135°28′E.	97.3	16.1	4.1	15
	Short 908 c.14km W. of Yorketown along main Warooka road, S.A. 35°02′S, 137°28′E.	91.4	17.7	4.5	15
Blennospora phlegmatocarpa	*Short 616* c.3.4km E. of Meckering in Mortlock River, W.A. 31°37′S, 117°02′E.	4,113.5	943.2	243.5	15

	Short 654 5.3km NW of Bruce Rock township on main road to Doodlakine, W.A. 31°52'S, 118°07'E.	4,176.5	766.1	197.8	15
	Short 679 Salt depression 1km E. of Wave Rock, W.A. 32°27'S, 118°51'E.	4,069.2	586.8	151.5	15
Blennospora drummondii	*Short 318* Granitic outcrop c.82.8km WSW of Coolgardie along main road to Perth, W.A. 31°11'S, 120°23'E.	204.2	27.7	7.1	15
	Short 376 c.23km N. of Geraldton on main Northampton road, W.A. 28°32'S, 114°39'E.	292.8	30.2	7.8	15
	Barker 4048 c.0.75km ENE of summit of Kaiserstuhl, S.A. 34°35'S, 139°00'E.	201	36.5	9.4	15
	Short 815 c.17 km from Pt. Lincoln along Flinders highway, S.A. 34°41'S, 135°46'E.	229.8	62.5	16.1	15
	Short 862 c.6km SW of Pt. Julia, S.A. 34°42'S, 137°49'E.	227.2	50.0	12.9	15
Chrysocoryne pusilla	*Chinnock 4335* Mt. Walker, W.A. 32°04'S, 118°45'E.	1,932.8	319.8	82.5	15
	Short 924 Wargangering Rock, W.A. 31°11'S, 120°31'E.	2,036.2	226.8	58.5	15
	Short 902 c.400m W. of Hesso in chenopod shrubland, S.A. 32°08'S, 132°27'E.	1,932.0	365.2	94.3	15
Chrysocoryne sp.B.	*Short 966* 45.1km N. of Koorda along main road to Mollerin, W.A. c.30°28'S, 117°31'E.	2,043.6	278.3	71.8	15
Chrysocoryne uniflora	*Short 614A* c.3.4km E. of Meckering in Mortlock River, W.A. 31°37'S, 117°02'E.	1,777.5	354.1	91.4	15
Chrysocoryne drummondii	*Short 598* c.31.3km E. of Dalwallinu on road to Kalannie, W.A. 30°17'S, 116°58'E.	139.0	13.4	3.4	15
	Short 691 c.12km W. of Lake King Post Office, W.A. 33°05'S, 119°31'E.	82.6	21.2	5.4	15
	Short 807 c.15.2km from Edillilie along main road to Pt. Lincoln, S.A. 34°31'S, 135°40'E.	144.2	21.3	5.5	15
Chrysocoryne sp.A.	*Short 1046* c.4.6km E. of Meckering in East Branch of Mortlock River, W.A. 31°37'S, 117°03'E.	105.8	34.3	8.8	15
Chrysocoryne sp.C.	*Short 605* c.4.8km S. of Kondut on main road to Wongan Hills, W.A. 30°45'S, 116°45'E.	41.2	9.4	2.4	15
	Short 614B c.3.4km E. of Meckering in Mortlock River, W.A. 31°37'S, 117°02'E.	51.7	9.3	2.4	15
	Short 632 Southern margins of Lake Brown, W.A. 31°07'S, 118°18'E.	52.8	9.2	2.3	15
Chthonocephalus sp. aff. pseudevax	*Short 394* c.100km N. of Murchison River Bridge on northwest coastal highway, W.A. 27°00'S, 114°38'E.	1,539.0	314.0	81.0	15

APPENDIX 2 (*Continued*)

Species	Population	Pollen-ovule ratio			
		Mean	± Standard Deviation	± Standard Error	n
Chthonocephalus pseudevax	*Short 322* c.12km from Carnamah on main road to Eneababba, W.A. 29°48'S, 115°50'E.	141.2	35.6	9.2	15
	Short 362 c.15km from Pindar toward Tardun, W.A. 28°34'S, 115°47'E.	152.9	30.5	7.8	15
	Short 375 c.23km N. of Geraldton on main Northampton road, W.A. 28°32'S, 114°39'E.	156.3	26.2	6.7	15
	Short 768 Carappee Hill, S.A. 32°25'S, 136°16'E.	152.5	23.3	6.0	15
Helipterum demissum	*Short 316* Small granite outcrop c.70km WSW of Coolgardie, W.A. c.31°11'S, 120°31'E.	91.8	17.9	4.6	15
	Short 867 c.6km SW of Pt. Julia, S.A. 34°42'S, 137°49'E.	77.3	15.8	4.0	15
Millotia tenuifolia	*Short 861* c.6km SW of Pt. Julia, S.A. 34°42'S, 137°49'E.	154.9	29.2	7.5	15
Myriocephalus rhizocephalus	*Short 813* c.7km NE of Wangary on road to Edillilie, S.A. 34°30'S, 135°31'E.	107.6	23.1	5.9	15
Pogonolepis stricta	*Short 1053* Saline flat running into Leschenault Inlet, c.3km from Bunbury, W.A. c.33°19'S, 115°41'E.	3,185.4	397.7	102.6	15
Pogonolepis sp.A.	*Short 372* c.13km from Pindar on Pindar-Mullawa road, W.A. 28°31'S, 115°41'E.	3,761.4	516.7	133.4	15
Pogonolepis muellerana	*Short 769* Waddikee Rocks, S.A. 33°11'S, 135°53'E.	226.3	28.6	7.3	15
	Short 777 Margins of Lake Yaninee, S.A. 33°00'S, 135°16'E.	270.8	43.8	11.3	15
	Short 811 4km N. of Cape Tournefort, S.A 34°55'S, 135°51'E.	160.8	43.4	11.2	15
	Short 821 c.6km SW of Pt. Julia, S.A. 34°42'S, 137°49'E.	208.9	23.2	5.9	15
	Short 870 As above.	250.8	32.4	8.3	15
	Short 906 c.9km from Pt. Wakefield along main road to Ardrossan, S.A. 34°07'S, 138°05'E.	245.4	53.1	13.7	15
Rutidosis multiflora	*Short 388* The Loop, Murchison River, Kalbarri National Park, W.A. 27°33'S, 114°26'E.	42.3	12.9	3.3	15
	Short 860 c.6km SW of Pt. Julia, S.A. 34°42'S, 137°49'E.	28.9	7.3	1.9	15
	Short 881 c.22km SSW of Casterton, V. 37°47'S, 141°21'E.	29.0	5.5	1.4	15
Toxanthes muelleri	*Short 873* c.3.2km N. of Douglas on southern margins of North Lake, V. 37°03'S, 141°45'E.	86.0	19.4	5.0	15
Helichrysum tepperi	*Short 868* c.6km SW of Pt. Julia, S.A. 34°42'S, 137°49'E.	c.37.5	—	—	15
Helipterum pygmaeum	*Short 865* c.6km SW of Pt. Julia, S.A. 34°42'S, 137°49'E.	c.252	—	—	15

APPENDIX 3

Pair Comparisons of the P/O's of Populations

Populations are designated by the collector's number; see appendix 2.
P = 0.05 or less.

Species	Populations	t	p level
Actinobole condensatum	417 vs 393 p.p.	2.113	0.05
Actinobole uliginosum	2646 vs 377	2.03	n.s.
	2646 vs 352	5.03	0.001
	2646 vs 872	6.36	0.001
	2646 vs 755	5.6	0.001
	2646 vs 864	7.29	0.001
	2646 vs 779	6.93	0.001
	377 vs 352	4.37	0.001
	377 vs 872	6.5	0.001
	377 vs 755	5.05	0.001
	377 vs 864	8.05	0.001
	377 vs 779	6.86	0.001
	352 vs 872	0.87	n.s.
	352 vs 755	1.23	n.s.
	352 vs 864	1.79	n.s.
	352 vs 779	2.19	0.05
	372 vs 755	0.62	n.s
	872 vs 864	1.09	n.s
	872 vs 779	1.64	n.s
	755 vs 864	0.11	n.s
	755 vs 779	0.71	n.s
	864 vs 779	0.81	n.s
Angianthus preissianus	908 vs 814	1.04	n.s
	908 vs 800	4.97	0.001
	908 vs 1013	8.32	0.001
	814 vs 800	4.19	0.001
	814 vs 1013	7.78	0.001
	800 vs 1013	4.4	0.001
Blennospora phlegmatocarpa	679 vs 616	0.15	n.s.
	679 vs 654	0.43	n.s.
	616 vs 654	0.2	n.s.
Blennospora drummondii	4048 vs 318	0.27	n.s.
	4048 vs 862	1.63	n.s.
	4048 vs 815	1.54	n.s.
	4048 vs 376	7.49	0.001
	318 vs 862	1.55	n.s.
	318 vs 815	1.73	0.05
	318 vs 376	8.36	0.001
	862 vs 815	0.16	n.s.
	862 vs 376	4.35	0.001
	815 vs 376	3.51	0.001
Chrysocoryne drummondii	691 vs 598	8.86	0.001
	691 vs 807	7.9	0.001
	598 vs 807	0.79	n.s.
Chrysocoryne sp.C.	605 vs 614B	3.05	0.001
	605 vs 632	3.38	0.001
	614B vs 632	0.31	n.s.
Chrysocoryne pusilla	902 vs 4335	0.005	n.s.
	902 vs 924	0.94	n.s.
	4335 vs 924	1.07	n.s.
Chthonocephalus pseudevax	322 vs 768	1.02	n.s.
	322 vs 362	0.96	n.s.
	322 vs 375	1.31	0.01
	768 vs 362	0.05	n.s.
	768 vs 375	0.41	n.s.
	362 vs 375	0.32	n.s.
Helipterum demissum	316 vs 867	2.35	0.05
Pogonolepis muellerana	811 vs 821	3.77	0.001
	811 vs 769	4.87	0.001
	811 vs 906	4.77	0.001
	811 vs 870	6.43	0.001
	811 vs 777	6.9	0.001
	821 vs 769	6.03	0.001
	821 vs 906	2.43	0.05
	821 vs 870	4.07	0.001
	821 vs 777	4.83	0.001
	769 vs 906	1.22	n.s.
	769 vs 870	2.19	0.05
	769 vs 777	3.29	n.s.
	906 vs 870	0.33	n.s.
	906 vs 777	1.42	n.s.
	870 vs 777	1.41	n.s.
Rutidosis multiflora	860 vs 881		n.s.
	860 vs 388		0.002
	881 vs 388		0.002

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NOTES ON A LITTLE KNOWN PUBLICATION BY SONDER ON THE MARINE ALGAE OF THE NEW HEBRIDES*

by

Doris M. Sinkora†

INTRODUCTION

While involved in preparing a bibliography of Ferdinand J. H. Mueller (Churchill, Muir & Sinkora, 1978) I located a paper by O. W. Sonder (1881) on a collection of marine algae from the New Hebrides. Four new species were described in the publication, which appears to have escaped the notice of subsequent monographers.

F. A. Campbell of Geelong, Victoria, who visited the New Hebrides from May 1872 to February 1873, collected plants on the islands at the suggestion of Mueller. When Campbell (1873) published his account of the journey, a paper on the vascular plants, prepared by Mueller, was included as an appendix. The algal collections were sent for study to O.W. Sonder in Hamburg, Germany. A manuscript drafted by Sonder was later submitted by Mueller to the Royal Society of Tasmania, of which Sonder was an honorary member. The paper was read at the Society's meeting on 13 April 1880, and subsequently published in their journal. Sonder's death on 21 November 1881, and the subsequent purchase by the Victorian Government of his herbarium and its removal to Melbourne would explain why the publication remained virtually unknown.

Sonder listed 23 species, of which four were described as new. Most of the relevant specimens, including the type material of the new species with Sonder's draft diagnoses, have been located in the National Herbarium of Victoria (MEL).

TYPIFICATION OF SONDER'S NEW SPECIES

The type sheets of the four new species are as follows:

Sarcodia polyclada Sonder (1881:13).

Holotype: MEL 516217.

The collection consists of a single specimen, which is sterile as stated by Sonder.

Caulerpa novo-ebudarum Sonder et F. Mueller in Sonder (1881:14).

Caulerpa vitiensis Sonder in herb.

Lectotype (here chosen): MEL 531063. Isolectotype: MEL 531064. ?Isolectotype: MEL 568235.

The material of this taxon locted in MEL consists of five specimen sheets from the Sonder herbarium, of which three are annotated in Sonder's hand as "Caulerpa vitiensis Sond.". Two of these three sheets (MEL 531063 and MEL 531064) are, in addition, annotated by Sonder with the locality and collector "New Hebrides. F. Campbell", while the third (MEL 531062) has Sonder's annotation of "Viti Archipelagus, Pacific Ocean". The remaining two specimen sheets have no Sonder annotations and are mounted together on MEL 568235 with a cross-reference to the three annotated sheets.

*The name of the New Hebrides was changed to Vanuatu with the gaining of independence on 30 July 1980.

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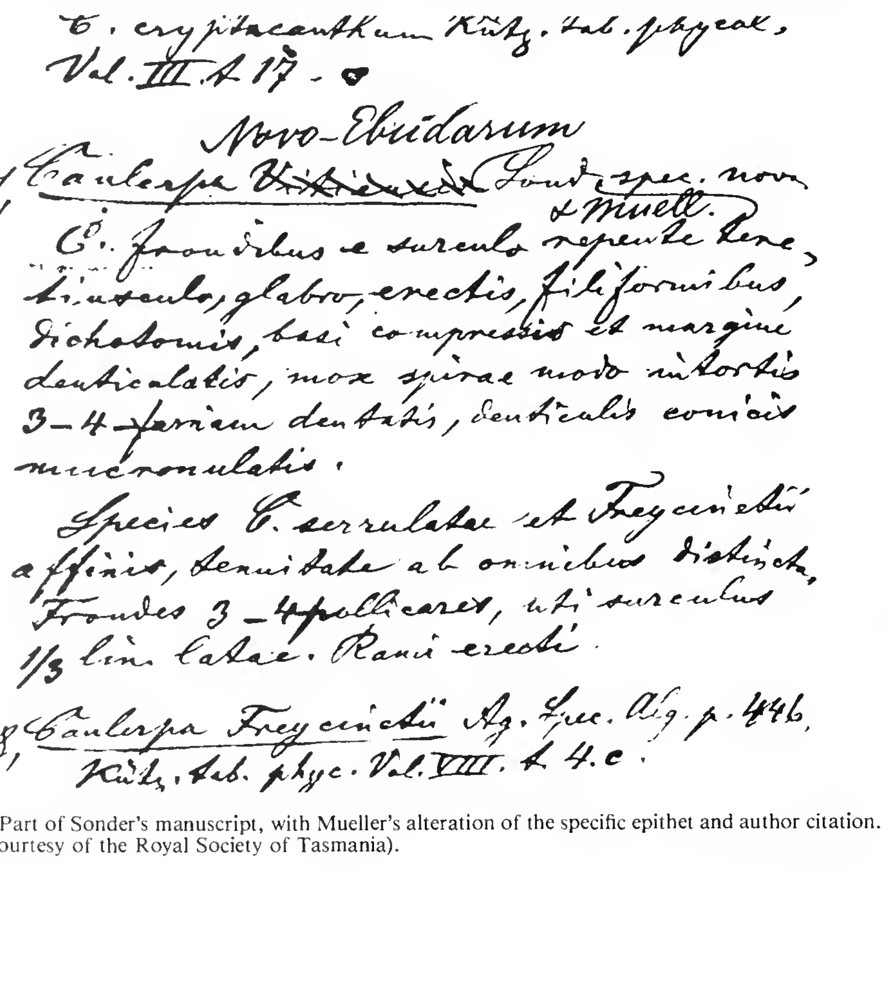
Muelleria 4(4): 419-422 (1981).

In the published description of the species (Sonder, 1881) no collections were specifically mentioned, but as the whole article applies to material gathered by Campbell in the New Hebrides both MEL 531063 and MEL 531064 are therefore type collections. However in Sonder's handwritten draft diagnosis (now mounted with the lectotype) he states "New Hebrides. F. Campbell. (Ins. Fidschi)". This statement could mean that Sonder mistakenly believed the New Hebrides to be part of the Fiji Islands. Alternatively, it could indicate that he was basing his diagnosis on New Hebrides material collected by Campbell but knew of, or had also seen, similar material from Fiji. The latter interpretation seems more likely as it is consistent with his method of citing collections in other papers (Sonder, 1871) and also with his locality annotations on the specimen sheets. MEL 531062 should therefore be regarded as further material examined although not cited by Sonder, but should not be granted type-status. Because the material of all five specimen sheets from the Sonder herbarium is very similar in appearance it is not possible to readily determine if MEL 568235 derives from Fiji or the New Hebrides. It could represent additional isolectotype material.

MEL 531063 has been chosen as the lectotype sheet because the specimen, although not large, was found mounted in such a way as to clearly display all the essential features mentioned in Sonder's description. The isolectotype (MEL 531064) mainly consists of erect fronds, with few, rather obscured, basal parts.

Sonder's manuscript, located in the Archives of the Royal Society of Tasmania (housed in the University of Tasmania Library), clearly shows that the name he suggested, *"Caulerpa vitiensis* Sond." was altered by Mueller to *"Caulerpa novo-ebudarum* Sond. & Muell." (fig. 1). Weber-van Bosse (1898) later adopted Sonder's


C. cryptacanthum Kütz. tab. phycol. Vol. VII. t. 17. –

Novo-Ebudarum

17, Caulerpa ~~Vitiensis~~ Sond. spec. nov. & Muell.

C. frondibus e surculo repente tereti, tenuiculo, glabro, erectis, filiformibus, dichotomis, basi compressis et margine denticulatis, mox spirae modo intortis 3–4-fariam dentatis, denticulis conicis mucronulatis.

Species C. serrulatae et Freycinetii affinis, tenuitate ab omnibus distincta. Frondes 3–4 pollicares, uti surculus 1/3 lin. latae. Rami erecti.

18, Caulerpa Freycinetii Ag. Spec. Alg. p. 446, Kütz. tab. phyc. Vol. VIII. t. 4. c.

Fig. 1. Part of Sonder's manuscript, with Mueller's alteration of the specific epithet and author citation. (Courtesy of the Royal Society of Tasmania).

original manuscript epithet *"vitiensis"* from a specimen in the British Museum and, apparently unaware of Sonder's 1881 publication, described the taxon under *Caulerpa urvilleana* Montagne var. *vitiensis* Weber-van Bosse (1898: 319, pl. 26, fig. 12 a & b). She listed as synonyms the two manuscript names "*C. vitiensis* Sonder, herb. du mus. Brit." and "*C. cupressoides* var *tenuis* Grunow, herb. Godefroy, Hambourg.", and mentioned two collections, "Viti-Archipel (Graeffe! herb. Godefr. herb. du mus. Brit.), les Nouv.-Hebrides (herb. de Melbourne!)". These two collections are therefore syntypes of *C. urvilleana* var. *vitiensis*.

Unfortunately the staff of the Department of Botany, British Museum (Natural History) have been unable to locate any specimen annotated "Caulerpa vitiensis" which might have been seen by Weber-van Bosse, and no specimen so annotated was recorded during a survey of the tropical *Caulerpa* collections in the Rijksherbarium, Leiden (I. R. Price, pers. comm.). Further investigation is needed to trace this specimen and compare it with MEL 531062 from "Viti Archipelagus, Pacific Ocean" in order to establish if the latter is, as seems likely, part of the same collection. Graeffe collected in Fiji in 1862 for the Godeffroy Museum in Hamburg, where Sonder no doubt examined and annotated the specimen apparently later seen at the British Museum by Weber-van Bosse.

Weber-van Bosse cited the New Hebrides collection as from the Melbourne herbarium and as seen (!) by herself. Her discussion following the description is remarkable in that she emphasized the lack of any stolon, a characteristic feature of the genus *Caulerpa*. Her fig. 12a shows a plant with an erect frond rising directly from rhizoids, without any stolon. However, all the specimens of the taxon in MEL show at least a short section of surculus. This would suggest that Weber-van Bosse never actually saw the Melbourne specimens, but was perhaps sent only a fragment without any basal parts. The Melbourne material she cited has not yet been traced.

Caulerpa campbelliana Sonder (1881:14).

Lectotype (here chosen): MEL 531060. Isolectotypes: MEL 531050, 531061.

Much of the type collection is poor and consists only of fragments of upper parts of erect fronds. MEL 531060 contains the most complete and best-preserved specimen and is therefore chosen as lectotype. It is the only specimen which shows the proliferations at the tips of the fronds mentioned in Sonder's description and adequately shows all the other features described. The lectotype specimen is accompanied by Sonder's draft diagnosis.

Chaetomorpha novo-ebudica Sonder (1881:14).

Chaetomorpha australis Sonder in herb.

Lectotype (here chosen): MEL 531058. Isolectotype: MEL 531059.

Here, again, the specific epithet proposed by Sonder was altered by Mueller, before he submitted the manuscript to the Royal Society of Tasmania.

The type collection consisted of one specimen sheet annotated by Sonder and here selected as lectotype, together with a quantity of loose material and two loose labels also annotated by Sonder. The loose material becomes isolectotype and is now mounted with the two labels on MEL 531059. The lectotype is accompanied by Sonder's draft diagnosis, with a pencil drawing of a magnified portion of a frond.

ACKNOWLEDGEMENTS

I wish to thank Dr I. R. Price, Botany Department, James Cook University of North Queensland, and Dr J. H. Ross and Miss H. I. Aston, National Herbarium of Victoria, for critical comment on the manuscript; Dr G. T. Kraft, Department of Botany, University of Melbourne, for discussion on the selection of lectotypes; the Honorary Secretary of the Royal Society of Tasmania, and Miss P. S. King, archivist, University of Tasmania Library, for supplying copies of Sonder's original manuscript.

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Manuscript received 14 July 1980.

A NEW SPECIES OF GREVILLEA (PROTEACEAE) FROM VICTORIA

by

R. V. Smith*

SUMMARY

Grevillea floripendula, a new species from a restricted area north of Beaufort in central-western Victoria is described, and its affinities with several related species discussed. Distribution and habitat notes are included.

DESCRIPTION

Grevillea floripendula R. V. Smith sp. nov.

Frutex magnus effusus ad 1 m altus × 3 m latus. Caules principes atque rami semi-prostrati vel decumbentes partibus infernis sed extrema ramulorum ± erecta. Partes caulium infernae mediaeque glabrae ad sparsim pubescentes, partes supernae dense pubescentes tomento pilorum ± patentium crispatorum tortorumve. Folia paulo remota, profunde dissecta in 5-7 lobis primariis oblongis quae 3-5 lobulos secundarios breves ± triangulares aculeatos ferunt. Lobae primariae secundariaeque foliorum de forma et amplitudine et numero valde variabiles. Folia matura clare viridia supra subnitentia vel glabra vel pilis parvis, crispatis tortisve, sparsim conspersa; infera pallide virens haud nitentia, pilis crispatis tortisve leniter conspersa. Florae racemis pendulis, secundis, 1-4 cm longis. Racemi teretos tenues ± glabros pedunculos 1-5 cm longos terminantes. Rachis racemi dense hirsuta. Bracteae florales vel ellipticae vel ovatae, vel ovato-rhombeae ad ovato-oblongae, (1.5-) 2-2.5 mm longae; planae, curvatae vel undulatae. Perianthium breve latumque, 5-6 mm longum (a medio tore ad summum arcum) extra dense hirsutum, pilis ± procumbentibus incanis; griseo-viride ad malvino-griseum nervis longitudinalibus malvinis vel purpureis; intra glabrum, inferne viride vel flavo-malvinum vel malvinum etc. superne atropurpureum ad arcum perianthii. Torus valde obliquus, nectario prominente ± semi-annulari incrassato. Stipes 1.5-2.5 mm longus. Ovarium prominente stipitatum, dense hirsutum pilis longis ferrugineis ± patulis, curvatis vel parum tortis. Stylus 7-9 mm longus, vivus pallide-flavus vel viridi-flavus vel roseus vel pallide ruber, siccitate nigrescente vel fuliginosus; glaber praeter basi ubi sparsim ad dense hirsutus. Fructus prominente stipitatus, 8-12 mm longus, 4-6 mm latus, extra dense hirsutus pilis mixtis brevioribus, rectioribus, ± procumbentibus atque multo longioribus, irregulatiter patentibus. Color principalis fructi griseus ad griseo-malvinus, cum vittis maculisve atropurpureis in superficiebus dorsalis lateralisque.

Shrub 0.3-1 m high and 1.5-3 m across. Main stems and branches semi-prostrate or decumbent. Lower and middle stems glabrous to sparsely pubescent, dark reddish or purplish-red; upper branches reddish, greyish-brown, or yellowish, becoming densely pubescent with a tomentum of whitish curled and twisted hairs. Tips of branches and young developing leaves pale ferruginous to reddish-purple. *Leaves:* petioles 3-5 (-8) mm long; blades broad- to oblong-triangular in outline, ± truncate to cuneate at the base, 1.5-4 cm long × 1.5-5 cm wide with length > to < width, ± deeply divided into 3-7 ± oblong *primary lobes* (0.5-)1-2(-2.5) cm long bearing 3-5 short ± triangular *secondary lobes,* each of which terminates in a short rigid slender prickle; lobing very variable. Upper surface of mature leaves bright green, sub-shiny, glabrous or with sparse, small, curled and twisted hairs; lower surface pale green, dull, sprinkled with similar hairs. Young leaves more strongly pubescent. *Flowers* in pendulous, secund, short and broad, occasionally somewhat elongated racemes (1-)2-3(-4) cm long × 2-3 cm wide, terminating a slender terete peduncle (1-)1.5-3(-5) cm long. *Peduncle* glabrous or occasionally sparsely pubescent, usually with a single bract arising from well above to well below its midpoint. Peduncle bent

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Muelleria 4(4): 423-427 (1981).

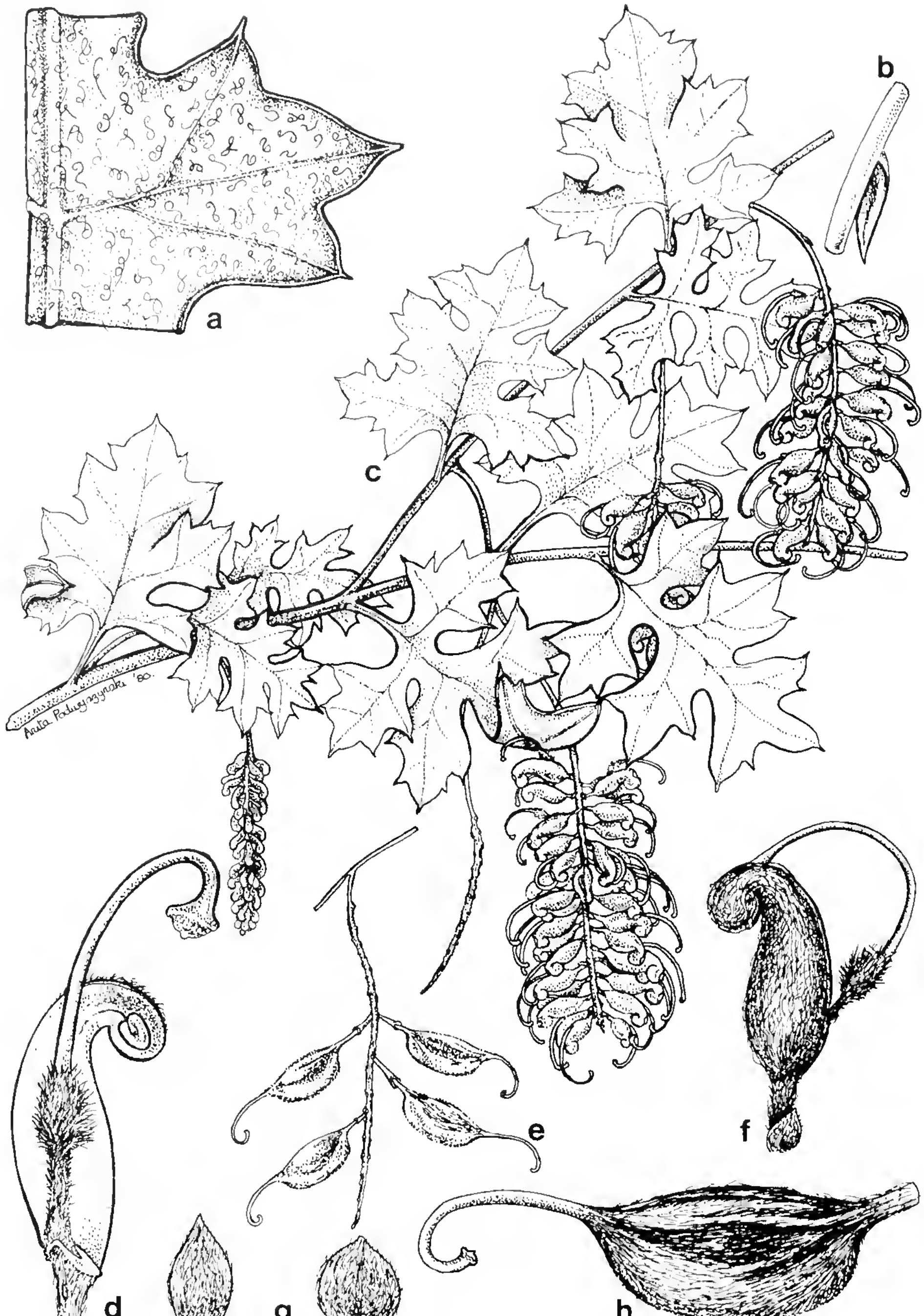

Fig. 1. *Grevillea floripendula*. a—lower surface of leaf showing venation and twisted hairs, x 3. b—portion of peduncle showing bract, x 6. c—habit, x 1. Note pendulous racemes. d—section through mature flower showing oblique torus, nectary, stipitate ovary, style and pollen presenter, x 5. e—fruiting raceme, x 1. f—young flower, x 4. Note floral bract at base of pedicel. g—floral bracts, x 8. h—mature fruit showing dark longitudinal patches on dorsal and lateral surfaces, x 3. a-d, f, and g, from Smith 76/23 (MEL); e and h from Smith 76/55 (MEL).

or geniculate at the bract and bearing a single raceme, or occasionally paired racemes. *Bract* (1-)2-3(-5) mm long, usually strongly infolded, sometimes flattish, narrow lanceolate with a usually acute, sometimes trifid tip; tip occasionally expanded into an incipient leaf with a small lobed lamina. *Rhachis* densely hairy with curved, curled or twisted hairs. *Floral bracts* flat, gently curved or undulate, spreading, elliptic, ovate, ovate-rhombic, to ovate-oblong 1.5-2(-2.5) mm long × 1-1.5 mm wide, from about as wide as long to longer than wide, bluntly pointed to acute, densely hairy on back, glabrous on front, greenish-yellow to reddish or purplish-tinged, from caducous (falling early from flowers) to persistent in fruit. *Pedicels* spreading at right angles to rhachis, 1.5-3 mm long, equalling or exceeding floral bracts, hairy. *Perianth* 5-6 mm long (from midpoint of torus to top of arch) × 2-3 mm wide (widest point of unopened perianth); densely hairy outside with predominantly appressed hairs mixed with irregularly spreading hairs, glabrous inside; outer surface greenish-grey to purplish-brown, with longitudinal nerves of mauve or purple, the colour partly obscured by the greyish-white hairs on body and light ferruginous hairs on limb; inner surface greenish to mauve in lower part, dark- or blackish-purple towards and around arch. *Anthers* 0.5-0.8 mm long, clear lemon yellow. *Torus* very oblique, with a prominent, thickened, semi-annular to ± horseshoe-shaped nectary. *Stipe* (1.5-)2-2.5 mm long, densely hairy with longish, appressed to spreading, pale grey hairs; stipe arising close to the summit of the torus and from slightly shorter to considerably longer than the ovary. *Ovary* prominently stipitate, densely hairy with long, erect to spreading, straight to curved or slightly twisted, pale, ferruginous hairs. *Style* 7-9 mm long, pale yellow, greenish-yellow, pale pink, or light red, curved, glabrous except at base where sparsely to strongly hairy, hairs occasionally extending up style for several mm. *Pollen presenter* (stigmatic disc) very oblique with a broad, strongly crenulate, greenish-yellow base rising to a low oblique cone with a pale yellowish stigmatic tip. *Fruit* prominently stipitate (8-)9-11(-12) mm long × 4-6 mm, densely hairy outside with a mixture of shorter, ± appressed to spreading, straight to waved hairs and much longer, spreading, curved to gently twisted hairs; hair colour grey to mauvish-grey, but blackish-purple in longitudinal bands or patches on the dorsal and lateral (and sometimes ventral) surfaces. *Seed:* body elliptic in outline, 5-7 mm long × 2-3 mm wide, pale yellowish-brown to blackish-purple, glabrous, smooth or minutely wrinkled, compressed, gently convex on back, ± flattened or depressed on front, surrounded by a thin, pale yellow wing from 0.5 mm wide to almost obsolete on the lateral margins, to 1-2 mm wide at top and bottom.

TYPE COLLECTION:

Ben Major Forest Reserve, gentle W. slopes of ridge, c.16 km N. of Beaufort, and c.300 m E. of Beaufort-Amphitheatre road, 37°18′S; 143°23′E, Central-western Victoria, R. V. Smith 76/23 (flowering collection), 15.x.1976 (Holotype: MEL 569949. Isotypes: MEL 571180-83, and to be distributed to A, AD, BRI, CANB, HO, K, NSW, PERTH).

PARATYPE:

Ibidem, R. V. Smith 76/55 (fruiting collection from same plant as holotype), 15.xii.1976 (MEL 569950 and 571184-86, duplicates to be distributed as for isotypes).

SELECTED SPECIMENS EXAMINED:

Victoria (central-western)—Ibidem for holotype: R. V. Smith 76/24 (MEL 571188-89, A, AD); R. V. Smith 76/25 (MEL 571190-91; BRI, HO, K, NSW). Ibidem for paratype: R. V. Smith 76/56 (MEL 571194-95, A, CANB, HO,

PERTH); R. V. Smith 76/57 (MEL 571196-97, PERTH). Near Troy's Reservoir, c.4 km N. of Beaufort, 37°24'S; 143°21'E, R. V. Smith 65/181, 9.xi.1965 (MEL 571203-05, AD, CANB, NSW). Slopes above Cockney Gully, 6.4-8 km N. of Beaufort, 37°21'S; 143°20'E, R. V. Smith 70/39, 16.xi.1970 (MEL 571198-200, AD, CANB, NSW); Ibidem, R. V. Smith 70/42, 16.xi.1970 (MEL 571201-02, A, HO, K, NSW). Crown land E. of Beaufort-Amphitheatre road, c.6.4-8 km N. of Beaufort, Mrs J. Reid 6.xi.1970 (MEL 571192-93).

Distribution and Habitat

Apparently confined to a very restricted area in central-western Victoria where it is known to the author from three locations north of Beaufort and east of the Beaufort-Amphitheatre road. Molyneux (1975) also cites Mount Ben Major, a few kilometres to the north. Occurs on Ordovician formation having shallow soils with quartz fragments and outcrops on or near the surface, in several plant associations which include the following species—*Eucalyptus dives, E. goniocalyx, E. obliqua, E. macrorhyncha, Acacia aculeatissima, A. gunnii, Correa reflexa, Daviesia ulicifolia, D. virgata, Dillwynia cinerascens, D. sericea, Epacris impressa, Gompholobium huegelii, Goodenia lanata, Leptospermum myrsinoides, Oxylobium procumbens* and *Pultenaea pedunculata.*

Discussion

Grevillea floripendula shows closest affinities with *G. steiglitziana* N. A. Wakefield, *G. dryophylla* N. A. Wakefield and *G. microstegia* W. M. Molyneux. From all of these species it differs most conspicuously in its pendulous racemes borne on elongated, slender, terete, wiry, glabrous or near-glabrous peduncles. It differs also from each of the above in a combination of other characters including both floral and tomentum details.

The floral bracts of *G. floripendula* show a marked similarity to those of *G. steiglitziana.* In both species they are flat or gently curved or undulate, and vary in shape from ovate to elliptic-oblong; cf. those of *G. dryophylla* and *G. microstegia* which are generally smaller, strongly concave, thickened in the lower part, from ovate-rhombic to broadly rhombic, and often considerably broader than long. Although resembling *G. steiglitziana* in floral bracts, *G. floripendula* can be distinguished readily by the pendulous racemes, the shorter styles (7-9 mm long; cf. (14-)15-20(-21) in *G. steiglitziana*) and the tomentum (strongly curved, waved, twisted and spreading; cf. closely appressed and "directional" in *G. steiglitziana*).

Molyneux (1975) considers that *G. microstegia* shows closest affinities with *G. floripendula* (referred to as "the undescribed *Grevillea* from the Ben Major area") and gives a comparative table of differences. After making detailed observations and measurements on all 4 species discussed in my present paper I consider that *G. microstegia* is, instead, most closely related to *G. dryophylla* on floral and bract characters. For *G. microstegia,* Molyneux gives the length of the floral bracts as "0.25 mm" and "c.0.5 mm" and states that the ovary stipe is inserted ± certrally on the torus. However, in specimens (including type) held at the National Herbarium of Victoria, I find that the floral bract length ranges from 0.5-1.3 mm while the ovary stipe arises on the upper part of the torus just below the summit, essentially as in *G. dryophylla.*

ACKNOWLEDGEMENTS

I wish to express my thanks and appreciation to Dr George A. M. Scott of the Botany Department, Monash University, for preparing the latin diagnosis; to Miss A. M. Podwyszynski, National Herbarium of Victoria, for preparing the accompanying illustration; to Mr Peter Farrington, Soil Conservation Authority, for first bringing my attention to *Grevillea floripendula* and for taking me to the type area in the Ben Major Forest, and finally to Mrs Jocelyn Reid of "Clover Hill" via Beaufort for taking me to the Cockney Gully area.

REFERENCE

Molyneux, W. M. (1975). A new *Grevillea* species from western Victoria. *Muelleria* 3: 141-145.

Manuscript received 15 September 1980.

A CONSPECTUS OF NEW RECORDS AND NOMENCLATURE FOR VASCULAR PLANTS IN VICTORIA 2. 1978-EARLY 1980.

by

MARY A. TODD*

CONTENTS

INTRODUCTION

This conspectus presents a comprehensive list of names, references and new records that have a bearing on the known vascular flora of Victoria and which update information given in Willis (1970, 1973) and in part 1 of this series (Todd, 1979, q.v.).

The information given here follows the same form as that given in part 1. Two additional grid references for localities are now used, i.e. O5 and O6 for the two ten-minute grid divisions into which the tip of Wilson's Promontory falls.

NEW RECORDS—INDIGENOUS PLANTS

Apium annuum P. S. Short, *J. Adelaide Bot. Gard.* 1: 230(1979). Umbelliferae. N50, 3 km SE of Laverton, *T. B. Muir 5651,* 25.xi.1977 (MEL 1510745).

Apium insulare P. S. Short, *J. Adelaide Bot. Gard.* 1: 228(1979). Umbelliferae. O6, Wattle Id. (off Wilson's Prom.), *Dr. Norman's group (Dept. Fisheries & Wildlife) 37,* late 1979 (MEL).

Apium prostratum Labill. ex Vent. ssp. **prostratum** var. **filiforme** (A. Rich.) Kirk, Stud. Fl. New Zealand 196(1899). Basionym: *Petroselinum filiforme* A. Rich., Fl. Nouv.-Zélande in Lesson and Richard Voy. l'Astrolabe. Bot. 278(1832). Umbelliferae. P. S. Short (l.c. 224-227) records this for Victoria. EKNPTWZ.

Apium prostratum ssp. **prostratum** var. **prostratum** is also in Victoria (Short, l.c.: 220-224). EKNT.

Aristida browniana Henrard, *Meded. Rijks-Herb.* 54B: 63(1926) and 58: 108, t. 38(1929). Gramineae. F47, 10 km WSW of Annuello, *J. Onans,* 22. viii. 1979 (MEL).

Baeckea ramosissima A. Cunn. ssp. **prostrata** (Hook.f.) G. W. Carr, **Telopea** 1: 416(1980). Basionym: *B. prostrata* Hook.f., Hook. Icon. P1. 3(2): t. 284(1840). Myrtaceae. DKOPWZ.

Baeckea ramosissima ssp. **ramosissima** is also recorded for Victoria by Carr (l.c. 414-415). DEHJMNRST.

Caladenia pusilla W. M. Curtis, Stud. Fl. Tas. 4A: 133(1980). Orchidaceae. Occurs in S.A., N.S.W., Vic., and Tas.

Croton verreauxii Baillon, Étude Gén. Euphorbiacées: 357(1858); Muell.-Arg. in *Linnaea* 34: 117(1865). Euphorbiaceae. Z23, beside Back Creek (between Mt.

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*National Herbarium of Victoria, Birdwood Avenue, South Yarra, Victoria, 3141.

Muelleria 4(4): 429-438 (1981).

Kaye & Noorinbee North), *W. Cane,* 1972. MEL holds fruiting material collected in 1979 from a bush grown in Miss J. Galbraith's garden at Tyers from a cutting collected by Cane at Back Creek in 1972.

Danthonia monticola J. W. Vickery, *Contr. N.S.W. Natl Herb.* 1: 299(1950). Gramineae. Grids CDJZ including J19, Grampians, Major Mitchell Plateau, above 2,800 ft., *A. C. Beauglehole ACB 16509,* 10.xii.1967 (MEL).

Deyeuxia decipiens (R.Br.) J. W. Vickery, *Contr. N.S.W. Natl Herb.* 1:70 (1940). Basionym: *Agrostis decipiens* R.Br., Prodr. Fl. Novae Holl. 172(1810). Gramineae. K27, the Otways, Benwerrin (NNW of Lorne), *A.C. Beauglehole ACB 43909,* 3.i.1974 (MEL).

Diplachne parviflora (R.Br.) Benth., Fl. Austr. 7: 620(1878). Basionym: *Triodia parviflora* R.Br., Prodr. Fl. Novae Holl. 182(1810). Gramineae. A16, 14th Street, Mildura, on a block of land on which a house has recently been built, *A. Bassham,* May, ?1978 (MEL).

Dysphania simulans F. Muell. & Tate ex Tate, *Trans. & Proc. Roy. Soc. S. Aust.* 8: 71(1886). Chenopodiaceae. A33, 21.8 km W of Nowingi, *J. H. Browne,* 29.vii.1979 (MEL).

Haloragis eichleri A. E. Orchard, *Bull. Auckland Inst. Mus.* No. 10: 88 (1975). Haloragaceae. E22, Cape Nelson Park, 9 km SSW of Portland P.O., very rare, *A. C. Beauglehole ACB 55368,* 14.xii.1976 (MEL).

Juncus aridicola L. A. S. Johnson in Black, Fl. S. Aust., ed. 3, pt 1 (revised Jessop): 322 (1978). Juncaceae. Grids AFGMR.

Juncus continuus L.A.S. Johnson, l.c. 325. Juncaceae. Grids RSTWZ.

Juncus flavidus L.A.S. Johnson, l.c. 325. Juncaceae. Grids ABCDGH JKMNPRSVWZ.

Koeleria australiensis Domin, *Biblioth. Bot.* 65: 127(1907). Gramineae. S16, Butcher's Spur on watershed between Macalister & Caledonia Rivers, *E. A. Chesterfield,* 19.xi.1973 (MEL). N. T. Burbidge (herbarium annotation) and J. Vickery query whether this species is truly endemic at this site.

Lomandra dura (F. Muell.) A. J. Ewart, *Proc. Roy. Soc. Vict.* 28: 219 (1916). Basionym: Xerotes dura F. Muell., *Trans. & Proc. Vict. Inst. Advancem. Sci.* 42(1855). Liliaceae. Q46, Murray Valley Highway, between Strathmerton and Yarroweyah, *T. B. Muir 4710,* 8.x.1969 (MEL).

Mirbelia rubiifolia (Andr.) G. Don, Gen. Syst. Gard. Bot. 2: 126(1832). Basionym: *Pultenaea rubiaefolia* Andr., Bot. Repos. t. 351(1804). Papilionaceae. Z35, circa 10 km SSW of Mallacoota, Philip Smith 19.i.1979 (MEL).

Najas marina L., Spec. P1. 1015(1753). Najadaceae. Z40, Swan Lake, NE of Sydenham Inlet, *A. Corrick & K. Bode,* 7.xii.1978 (MEL). See Aston, *Vict. Nat.* 96: 67(1979).

Prostanthera incana A. Cunn. ex Benth., Labiatarum Genera Spec. 455(1832-1836). Labiatae. W? 20, Macdonalds Gap Road about 4 km from Dargo, *W. Cane,* 18.xi.1979 (MEL).

Sclerolaena intricata (R. H. Anderson) A. J. Scott, *Feddes Repert. Spec. Nov. Regni Veg.* 89: 113(1978). Basionym: *Bassia intricata* R. H. Anderson, *Proc. Linn. Soc. N.S.W.* 48: 340(1923). Chenopodiaceae. A2, 1.6 km NW of Lake Walla-Walla, *J. H. Browne,* 1.x.1978 (MEL).

Sclerolaena ventricosa (J. M. Black) A. J. Scott, *Feddes Repert. Spec. Nov. Regni Veg.* 89: 114(1978). Chenopodiaceae. A15, 11.5 km SW of Wentworth, *J. H. Browne,* 8.ix.1979 (MEL 558665).

Solenogyne dominii L. G. Adams, *Brunonia* 2: 58(1979). Synonym: *Lagenophora* [*gunnii?*] var. *glabra* Domin, *Biblioth. Bot.* 89: 653(1929) – nom. inval. Compositae. Grids CJKMN e.g. K14, Mt. Gellibrand, *F. Muell.* (date ?) (MEL 36730-36732).

Veronica hillebrandii F. Muell., *Trans. Philos Soc. Vict.* 1: 49(1855). Scrophulariaceae. E21, Portland, Bridgewater, *A. Taylor* (for A. C. Beauglehole) *ACB 8400,* x.1946 (MEL).

NEW RECORDS—INTRODUCED SPECIES

All species listed have been found growing spontaneously in Victoria at least once in recent years. An asterisk (*) denotes those which seem to have become naturalized.

***Amaranthus powellii** S. Watson, *Proc. Amer. Acad. Arts* 10: 347 (1875). Amaranthaceae. Grids MNVWZ, including M27, Shepparton, open paddock *R. V. Smith 64/122*, 19.v.1964 (MEL).

***Bidens pilosa** L., Spec. P1. 832(1753). Compositae. Grids ANX, including A45, Hattah Lakes National Park (house area), *G. W. Anderson,* 30.ix.1969 (MEL).

Cerastium semidecandrum L., Spec. P1. 438(1753). Caryophyllaceae. E12/E13/E21/E22, Portland—Bats' Ridges, *A. C. Beauglehole ACB 19959,* 5.x.1950 (MEL).

Cestrum elegans (Brongn.) Schlecht., *Linnaea* 19: 261(1847). Basionym: *Habrothamnus elegans* Brongn. ex Neumann, *Ann. Fl. Pomone,* 118 (1844). Solanaceae. (The specimens going under this name in Australian gardens have hairs on the outer surface of the upper part (limb) of the corolla. These hairs are not mentioned for *C. elegans* in Francey's revision in *Candollea* 6: 123(1935)). N54, Sassafras Creek, beside Sassafras Creek Road, *G. Edwards,* 14.i.1979 (MEL).

***Hydrocleys nymphoides** (H. & B. ex Willd.) Buch. in *Abh. Naturwiss. Vereine Bremen* 2: 2(1868). Basionym: *Stratiotes nymphoides* H. & B. ex Willd. Linn. Spec. P1. 4: 821(1806). Butomaceae. Grids S45 and W37 (one population about 1 km long in a gully 17 km N of Maffra). Known to have originated from material planted upstream 10-15 years previously. See Aston & Jacobs, *Muelleria* 4: 285-293(1980).

Hydrocotyle bonariensis Lam., Encycl. Meth. Bot. 3: 153(1789). Umbelliferae. Z38, Cape Conran, *P. Rennick,* 12.xii.1978 (MEL).

***Plantago australis** Lam., Tableau Encycl. Meth. 1: 339(1792). Plantaginaceae. Grids K,N,T including N45, Woori Yallock Creek, ± 2 km SW of Yellingbo, *A. C. Beauglehole ACB 50433,* 23.iii.1976 (MEL).

Pontederia cordata L., Spec. P1. 288(1753). Pontederiaceae. Grids D and P. See Aston, *Vict. Nat.* 96: 67-69(1979).

Salvia aurea L., Spec. P1., ed. 2, 38(1762). Labiatae. E26, Port Fairy on East beach, *A. Arnold,* 13 or 14.xi.1978 (MEL).

CHANGES OF NOMENCLATURE

Inclusion of a name on this list does not necessarily imply that the associated nomenclatural change is taxonomically acceptable to the present author, or to other taxonomists.

Acacia armata R.Br. See *A. paradoxa.*

Acacia x **grayana** J. H. Willis. Confirmed as hybrids between *A. brachybotrya* Benth. and *A. calamifolia* Sweet ex Lindley on the basis of morphology, chemistry and ecology. See Leach & Whiffin, *Bot. J. Linn. Soc.* 76: 53-69(1978).

Acacia longifolia (Andrews) Willd. var. **sophorae** (Labill.) F. Muell. Considered a distinct species, *A. sophorae,* q.v.

Acacia paradoxa DC., Cat. Pl. Horti Bot. Monspel. 74(Mar.1813). Synonym: *A. armata* R.Br. in Ait., Hortus Kewensis ed. 2, 5: 463(Dec.1813), teste Pedley, *Austrobaileya* 1: 250(1979).

Acacia sophorae (Labill.) R.Br., regarded as a separate species from *A. longifolia* (Andrews) Willd. by Murray, Ashcroft, Seppelt and Lennox (*Austral. J. Bot.* 26: 756(1978)) on the basis of differences in chemical constituents.

Apium leptophyllum (Pers.) F. Muell. See *Ciclospermum leptophyllum.*
Arthrocnemum arbusculum (R.Br.) Moq. See *Pachycornia arbuscula.*
Bassia biflora (R.Br.) F. Muell. See *Dissocarpus biflorus.*
Bassia biflora var. **cephalocarpa** (F. Muell.) R. H. Anderson. See *Dissocarpus biflorus* var. *cephalocarpa.*
Bassia birchii (F. Muell.) F. Muell. See *Sclerolaena birchii.*
Bassia brachyptera (F. Muell). R. H. Anderson. See *Sclerochlamys brachyptera.*
Bassia caput-casuarii J. H. Willis. See *Sclerolaena caput-casuarii.*
Bassia diacantha (Nees) F. Muell. See *Sclerolaena diacantha.*
Bassia divaricata (R.Br.) F. Muell. See *Sclerolaena divaricata.*
Bassia intricata R. H. Anderson. See *Sclerolaena intricata* in New Records—Indigenous Plants.
Bassia obliquicuspis R. H. Anderson. See *Sclerolaena obliquicuspus.*
Bassia paradoxa (R.Br.) F. Muell. See *Dissocarpus paradoxa.*
Bassia parviflora R. H. Anderson. See *Sclerolaena parviflora.*
Bassia patenticuspis R. H. Anderson. See *Sclerolaena patenticuspus.*
Bassia quinquecuspis (F. Muell.) F. Muell. See *Sclerolaena muricata.*
Bassia quinquecuspis var. **villosa** (Benth.) R. H. Anderson. See Scler*olaena muricata* var. *villosa.*
Bassia ramsayae J. H. Willis. See *Sclerolaena ramsayae.*
Bassia stelligera (F. Muell.) F. Muell. See *Stelligera endecaspinis.*
Bassia tricuspis (F. Muell.) R. H. Anderson. See *Sclerolaena tricuspis.*
Bassia uniflora (R.Br.) F. Muell. See *Sclerolaena uniflora.*
Blakeochloa paradoxa (R.Br.) Veldkemp, *Taxon* 29: 296(1980). Basionym: *Danthonia paradoxa* R.Br. Synonym: *Plinthanthesis paradoxa* (R.Br.) S. T. Blake. See *Danthonia.*
Caladenia carnea R.Br. See *C. catenata.*
Caladenia carnea R.Br. var. **gigantea** R. S. Rogers. See *C. catenata* var. *gigantea.*
Caladenia catenata (Sm.) Druce in *Rep. Bot. Soc. Exch. Club Brit. Isles* 1916: 611(1917). Basionym: *Arethusa catenata* Sm. Exot. Bot. t. 104 (1804-06). Synonym: *C. carnea* R. Br., teste W. M. Curtis, Stud. Fl. Tas. 4A: 106(1980).
Caladenia catenata (Sm.) Druce var. **gigantea** (R. S. Rogers) W. M. Curtis, Stud. Fl. Tas. 4A: 133(1980). Synonym: *C. carnea* R.Br. var. *gigantea* R. S. Rogers.
Caladenia huegelii Reichenb.f. var. **reticulata** (R. D. FitzG.) J. Z. Weber & R. Bates in J. M. Black, Fl. S. Aust. ed. 3, pt 1 (revised Jessop): 397(1978). Synonym: *C. reticulata* R. D. FitzG. See R. Bates in *Native Orchid Soc. S. Aust. J.* 3: 16(1979).
Caladenia reticulata R. D. FitzG. See. *C. huegelii* var. *reticulata.*
Ciclospermum leptophyllum (Pers.) Sprague, *J. Bot.* 1923, 61: 131 in obs. (as Cyclospermum). Synonym: *Apium leptophyllum* (Pers.) F. Muell. teste Short, *J. Adelaide Bot. Gard.* 1: 205, 206, 233(1979).
Cyperus hamulosus Bieb., Fl. Taur.-Caucasica 1: 35(1808). Synonym: *Scirpus hamulosus* (Bieb.) Steven. See Raynal, *Adansonia,* ser. 2, 6: 581-88(1967).
Cyperus lhotskyanus Boeck., *Bot. Jahrb. Syst.* 5: 498(1884). Synonym: *C. rutilans* (C. B. Clarke) Maiden et Betche. See K. Wilson, *Telopea* 1: 464(1980).
Cyperus rutilans (C. B. Clarke) Maiden & Betche. See *C. lhotskyanus* Boeck.
Danthonia Lam. & DC. Pending a revision of the genus *Danthonia* on a worldwide basis it seems best to continue to use this name for the 24 species that Willis (1970) placed in *Danthonia* and the additional species (*D. monticola* Vickery) which is recorded for Victoria on p. 430 of this paper. Studies by Zotov (1963) and Blake (1962) showed proposals for a number of new names to be applied to 12 of these species and the situation was summarized in the first number of this Conspectus (Todd 1979: 188). Since then two major papers have been published on this subject.

Connor & Edgar (*New Zealand J. Bot.* 17: 311-337(1979)), revised the New Zealand species of *Danthonia* which had been placed in *Notodanthonia* by Zotov and referred them all to the genus *Rytidosperma* Steudel, an earlier valid name for *Notodanthonia.* They also made combinations under *Rytidosperma* for the Australian species which they regarded as referable to that genus. Connor & Edgar (l.c., 312) also summarized the literature published since 1963 on *Danthonia* sensu lato and noted that Conert (1971, 1975) and Kabuye & Renvoize (1975) both allude to the need for study of American taxa.

The second paper (Veldkamp, *Taxon* 29: 293-298(1980)) included a proposal to conserve the name *Notodanthonia* against three earlier names (*Plinthanthesis* Stuedel (1853) non S. T. Blake (1972), *Rytidosperma* Steudel (1854) and *Monostachya* Merr. (1910)) on the grounds that it is best known for the genus, longest in general use and requires the fewest new combinations. Veldkamp also made the remaining new combinations required under *Notodanthonia,* including Australian species. He included *D. pallida* R. Br. in *Notodanthonia* while Connor & Edgar commented on the chionochlooid disposition of its lemma hairs and excluded it from *Rytidosperma* for that reason. They did not, however, publish the appropriate combination under *Chionochloa.*

The new name *Blakeochloa* Veldkamp was published (Veldkamp, l.c.: 296 (1980)) for the species that Blake referred to *Plinthanthesis* and the necessary new combinations made (see *B. paradoxa*).

Worldwide revision of the genus *Danthonia* sensu lato may show that it is desirable to separate the genus for which it is proposed that the name *Notodanthonia* be conserved. By that time it is likely that the decision regarding the conservation of the name *Notodanthonia* will have been made. In the meantime the use of the name *Danthonia* sens. lat. for the species in Victoria is recommended.

Danthonia tenuior (Steudel) Conert, *Senckenberg. Biol.* 56(1/3): 163(1975). Basionym: *Plinthanthesis tenuior* Steudel, Syn. Pl. Glumac., Pars l. Gramin. 14(1854). Synonym: *D. purpurascens* Vickery.

Daviesia arenaria M. D. Crisp, *J. Adelaide Bot. Gard.* 2: 163(1980). Synonym: *D. ulicina* Sm. var. *ruscifolia* (A. Cunn. ex Benth.) J. M. Black, non *D. ruscifolia* A. Cunn. ex Benth. Included in *D. ulicifolia* Andr. by J. H. Willis (1973, 258).

Daviesia ulicina Sm. var. **ruscifolia** (A. Cunn. ex Benth.) J. M. Black. See *D. arenaria.*

Dissocarpus biflorus (R.Br.) F. Muell., *Trans. Phil. Inst. Vict.* 2: 75(1858). Basionym: *Sclerolaena biflora* R.Br. Synonym: *Bassia biflora* (R.Br.) F. Muell. teste Scott, *Feddes Repert. Spec. Nov. Regni Veg.* 89(2-3): 118(1978).

Dissocarpus biflorus var. **cephalocarpa** (F. Muell.) A. J. Scott, *Feddes Repert. Spec. Nov. Regni Veg.* 89(2-3): 118(1978). Basionym: *Sclerolaena biflora* var. *cephalocarpa* F. Muell., Fragm. Phytogr. Austr. 8: 38(1873). Synonym: *Bassia biflora* var. *cephalocarpa* (F. Muell.) R. H. Anderson.

Dissocarpus paradoxa (R.Br.) F. Muell. ex Ulbrich in Engler & Harms, *Natürl. Pflanzenfam.,* ed. 2, 16c: 533(1934). Basionym: *Sclerolaena paradoxa* R.Br. Synonym: *Bassia paradoxa* (R.Br.) F. Muell. teste Scott, l.c. 118.

Epilobium adenocaulon Hausskn. See *E. ciliatum* Raf. ssp. *ciliatum.*

Epilobium ciliatum Raf., Med. Repos. II. 5: 361(1808) ssp. **ciliatum**. Synonym: *E. adenocaulon* Hausskn. teste Hock & Raven, *Ann. Missouri Bot. Gard.* 64(1): 136(1977).

Eucalyptus angophoroides R. T. Baker, *Proc. Linn. Soc. N.S.W.* 25: 676, t. 46, figs. 4a-c(1901). Willis (1973, 431) included this species in *E. bridgesiana* R. T. Baker. M. I. H. Brooker, CSIRO Div. Forest Research (pers. comm. March, 1979) regards the two species as distinct.

Eucalyptus bridgesiana R. T. Baker. See *E. angophoroides.*

Eucalyptus leucoxylon F. Muell. ssp. **leucoxylon.**—Boland, *Austral. Forest Res.* 9: 66(1979), has chosen a new lectotype for this species. He gives the following as synonyms: *E. leucoxylon* var. *rugulosa* F. Muell. ex Miq., Miquel, Ned.

Kruidk. Arch. 4: 127(1856); *E. leucoxylon* var. *erythrostema* F. Muell. ex Miq., Miquel, Ned. Kruidk. Arch. 4: 127(1856) and *E. leucoxylon* var. *angulata* Benth., Fl. Austr. 3: 210(1867) pro parte.

Eucalyptus leucoxylon var. **erythrostema** sens. Willis (1973, 422). See *E. leucoxylon* ssp. *megalocarpa.*

Eucalyptus leucoxylon ssp. **megalocarpa** Boland, *Austral. Forest Res.* 9: 68(1979)—"a sub-species differing from ssp. *leucoxylon* in the longer fruit (more than 25 mm long)". This is from the population which J. E. Brown described as var. *macrocarpa*—a name which was illegitimate when published as it included the previously published taxon var. *erythrostema* F. Muell. ex Miq. Boland considers the latter to be within *E. leucoxylon* ssp. *leucoxylon.*

Eucalyptus leucoxylon ssp. **pruinosa** (F. Muell. ex Miq.) Boland, *Austral. Forest Res.* 9: 68(1979). Basionym: *E. leucoxylon* var. *pruinosa* F. Muell. ex Miq., *Ned. Kruidk. Arch.* 4: 127(1856). Synonym: *E. leucoxylon* var. *pauperita* J. E. Brown, Forest Fl. S. Aust. (1883).

Eupatorium adenophorum Spreng., Syst. Veg. 3: 420(1826). Synonym: *E. glandulosum* auct. non Michx. teste Auld, *J. Austral. Inst. Agric. Sci.* 146-147 (Sept./Dec. 1977).

Eupatorium glandulosum auct. non. Michx. See *E. adenophorum* Spreng.

Ferraria crispa Burm., *Nova Acta Acad. Caes. Leop.-Carol. German. Nat. Cur.* 2: 199(1791) ssp. **crispa.** Synonym: *F. undulata* L., Spec. Pl., ed. 2, 2: 1353(1763)—nom. superfl., teste M. P. de Vos, *J. S. African Bot.* 45: 341(1979).

Ferraria undulata L. See *F. crispa* ssp. *crispa.*

Fimbristylis squarrosa Vahl in Victoria. See *F. velata.*

Fimbristylis velata R.Br., Prodr. Fl. Novae Holl. 227(1810). Synonym: *F. squarrosa* Vahl var. *esquarrosa* Makino, *Bot. Mag. (Tokyo)* 17: 47(1903) teste Govindarajalu, *Reinwardtia* 8: 509-13(1974). Victorian specimens at MEL confirm Jessop's view (Black, Fl. S. Aust., ed. 3, pt 1 (revised Jessop): 273(1978)) that var. *esquarrosa* is the variety of *F. squarrosa* which is present in Australia.

Gladiolus cuspidatus Jacq. See *G. undulatus.*

Gladiolus undulatus L., Mant. Pl.1: 27(1769). Synonym: *G. cuspidatus* Jacq. teste Lewis et al., *J. S. African Bot. Suppl. Vol.* 10: 110(1972).

Kickxia elatine (L.) Dumort. Material in Victoria all appears to belong to the ssp. *crinita* (Mabille) W. Greuter, *Boissiera* 13: 108(1967), (synonym: *K. sieberi* (Reichenb.) Dorfl.). As far as can be seen from the collections at MEL the ssp. *elatine* has not been collected in Victoria (R. V. Smith, pers. comm. July, 1979. Tutin et al., Fl. Europaea 3: 238(1972) was consulted in coming to these conclusions).

Kickxia sieberi (Reichenb.) Dorfl. See *K. elatine.*

Leichardtia is the correct spelling for this generic name (Bullock, *Kew Bull.* 1956: 287(1956)).

Limonium lobatum (L. f.) O. Kuntze, Revisio Generum Pl. 2: 395(1891). Basionym: *Statice lobata* L.f., Suppl. 187(1781). Synonym: *L. thouinii* (Viv.) O. Kuntze teste Erben, *Mitt. Bot. Staatssamml. München* 14: 395-397(1978).

Limonium thouinii (Viv.) O. Kuntze. See *L. lobatum.*

Luzula australasica auct. non Steudel. Teste Jansen, *Blumea* 24: 527-532(1978), Tasmanian material referred to *L. australasica* by Nordenskiöld, *Bot. Not.* 122: 79(1969) and Edgar, *N. Zealand J. Bot.* 13: 781-802(1975) is referable to *L. modesta* Buchenau (endemic in Tasmania), while mainland material, including Victorian, referred to *L. australasica* by Nordenskiöld, l.c., is referable to *L. ovata* Edgar.

Luzula australasica Steudel (1855). The type has now been located in Paris and is referable to the taxon formerly known as *L. oldfieldii* Hook.f. (1858), a Tasmanian endemic. As *L. australasica* is the older name it must now be applied to this taxon, which becomes *L. australasica* Steudel ssp. *australasica*. For the names which should now be used for the taxa formerly known as *L. australasica* see *L. australasica* auct. non Steudel. See Jansen, *Blumea* 24: 527-32(1978).

Luzula australasica Steudel ssp. **dura** (Edgar) M. Jansen, *Blumea* 24: 531 (1978). Basionym: *L. oldfieldii* Hook.f. ssp. *dura* Edgar, *New Zealand J. Bot.* 13: 789(1975).

Luzula modesta Buchenau (a Tasmanian endemic). See *L. australasica* auct. non Steudel.

Luzula oldfieldii Hook.f. See *L. australasica* Steudel.

Luzula oldfieldii Hook.f. ssp. **dura** Edgar. See *L. australasica* Steudel spp. *dura.*

Microtis oblonga R. S. Rogers. See *M. rara.*

Microtis rara R.Br., Prodr. Fl. Novae Holl. 321(1810). Synonym: *M. oblonga* R. S. Rogers, teste W. M. Curtis Stud. Fl. Tas. 4A: 59(1980).

Nicandra physalodes (L.) Gaertn. This spelling and authority replaces *N. physaloides* Gaertn. Basionym: *Atropa physalodes* L., Spec. Pl. 181(1753). See Horton, *J. Adelaide Bot. Gard.* 1: 351-352(1979).

Nicandra physaloides *Gaertn.* See *N. physalodes.*

Notodanthonia Zotov. See *Danthonia.*

Oplismenus aemulus (R.Br.) Roem. & Schult. See *O. hirtellus.*

Oplismenus hirtellus (L.) P. Beauv., Essai Nouv. Agrost. 54, 170(1812). Basionym: *Panicum hirtellum* L., Syst. Naturae ed. 10,2: 870(1759). Synonyms: *O. aemulus* (R.Br.) Roem. & Schult.; *O. imbecillis* (R. Br.) Roem. & Schult., Syst. Veg. 2: 487(1817).

Oplismenus imbecillis (R.Br.) Roem. & Schult. See *O. hirtellus.*

Oxalis corniculata L. Lourteig, *Phytologia* 42: 57-198(1979), in a worldwide revision of *Oxalis* sect. Corniculatae DC., records the presence of this introduced species in Victoria and also that of the native *O. perennans* Haw. which has previously been included in *O. corniculata* L. in Australia. She also records the presence in Victoria of *O. exilis* Cunningham, *Ann. Nat. Hist.* 3: 316(1839), and *O. radicosa* A. Richard, Tentamen Fl. Abyssinicae 1: 123(1847). Whether these are distinct enough to be separated from *O.corniculata* remains to be checked in field and laboratory studies.

Pachycornia arbuscula (R.Br.) A. J. Scott, *Bot. J. Linn. Soc.* 75: 369(1977). Basionym: *Salicornia arbuscula* R.Br. Synonym: *Arthrocnemum arbusculum* (R.Br.) Moq.

Parentucellia latifolia (L.) Caruel in Parl., Fl. Italiana 6: 842(1885). Ssp. *latifolia* is the subspecies naturalized in Australia. See Hedge, *Notes Roy. Bot. Gard. Edinburgh* 36: 11(1978).

Plantago arenaria Waldst. & Kit., Descript. Icon. Pl. Rariorum Hungariae 1:51(1801). Synonyms: *P. psyllium* L., nom. ambig.; *P. indica* L., nom. illegit. teste D. Cartier in Tutin et al., Fl. Europaea 4: 43(1976).

Plantago indica L., nom. illegit. See *P. arenaria.*

Plinthanthesis Steudel (1853) non S. T. Blake. See *Danthonia.*

Plinthanthesis paradoxa (R.Br.) S. T. Blake. See *Blakeochloa paradoxa.*

Prasophyllum album R. S. Rogers. Synonym: *P. odoratum* R. S. Rogers var. *album* (R. S. Rogers) R. S. Rogers. See W. M. Curtis, Stud. Fl. Tas. 4A: 69(1980).

Prasophyllum fuscum R.Br. var. **fuscum.** Synonym: *P. gracile* R. S. Rogers non Lindl. See Weber & Bates in J. M. Black, Fl. S. Aust., ed. 3, pt 1 (revised Jessop): 429(1978), and Bates in *Native Orchid Soc. S. Aust. J.* 3: 16(1979).

Prasophyllum gracile R. S. Rogers non Lindl. There are differing opinions about this taxon. See *P. fuscum* var. *fuscum.* See also W. M. Curtis, Stud. Fl. Tas. 4A: 72(1980).

Prasophyllum odoratum R. S. Rogers. There are differing opinions about the status of this taxon. See *P. patens* var. *patens.* See also W. M. Curtis, Stud. Fl. Tas. 4A: 68(1980).

Prasophyllum odoratum R. S. Rogers var. **album** (R. S. Rogers) R. S. Rogers. There are differing opinions about the status of this taxon. See *P. album* and *P. patens* var. *patens.*

Prasophyllum patens R.Br. var. **patens.** Synonym: *P. odoratum* R. S. Rogers and *P. odoratum* R. S. Rogers var. *album* (R. S. Rogers) R. S. Rogers. See Weber & Bates in J. M. Black, Fl. S. Aust., ed. 3, pt 1 (revised Jessop): 434(1978), and Bates in *Native Orchid Soc. S. Aust. J.* 3: 17(1979).

Pterostylis alata (Labill.) Reichenb.f. var. **robusta** (R. S. Rogers) J. Z. Weber & R. Bates in J. M. Black, Fl. S. Aust., ed. 3, pt 1 (revised Jessop): 437(1978). Basionyn: *P. robusta* R. S. Rogers. Synonym: *P. scabra* Lindl. var. *robusta* (R. S. Rogers) A. S. George. See Bates in *Native Orchid Soc. S. Aust. J.* 3:18(1979).

Pterostylis aphylla Lindl., Genera & Spec. Orchidaceous Pl. 392(1840). Considered to be distinct from *P. parviflora* R.Br. in Tasmania. See W. M. Curtis, Stud. Fl. Tas. 4A: 24(1980).

Pterostylis parviflora R.Br. See *P..aphylla.*

Pterostylis scabra Lindl. var. **robusta** (R. S. Rogers) A. S. George. See *P. alata* var. *robusta.*

Rytidosperma Steudel. See *Danthonia.*

Salicornia blackiana Ulbrich. See *Sarcocornia blackiana.*

Salicornia quinqueflora Bunge ex Ungern-Sternberg. See *Sarcocornia quinqueflora.*

Sarcocornia blackiana (Ulbrich) A. J. Scott, *Bot. J. Linn. Soc.* 75: 369 (1977). Basionym: *Salicornia blackiana* Ulbrich.

Sarcocornia quinqueflora (Bunge ex Ungern-Sternberg) A. J. Scott, *Bot. J. Linn. Soc.* 75: 368(1977). Basionym: *Salicornia quinqueflora* Bunge ex Ungern-Sternberg.

Scirpus hamulosus (Bieb.) Steven. See *Cyperus hamulosus.*

Sclerochlamys brachyptera F. Muell. Synonym: *Bassia brachyptera* (F. Muell.) R. H. Anderson teste Scott, *Feddes Repert. Spec. Nov. Regni Veg.* 89: 115(1978).

Sclerolaena birchii (F. Muell.) Domin, *Biblioth. Bot.* 89: 623(1921). Synonym: *Bassia birchii* (F. Muell.) F. Muell. teste Scott, l.c. 111.

Sclerolaena caput-casuarii (J. H. Willis) A. J. Scott, *Feddes Repert. Spec. Nov. Regni Veg.* 89: 111(1978). Basionym: *Bassia caput-casuarii* J. H. Willis.

Sclerolaena diacantha (Nees) Benth., Fl. Austr. 5: 194(1870). Synonym: *Bassia diacantha* (Nees) F. Muell. teste Scott, l.c. 112.

Sclerolaena divaricata (R.Br.) Domin, *Biblioth. Bot.* 89: 624(1921). Basionym: *Anisacantha divaricata* R.Br. teste Scott, l.c. 112. Synonym: *Bassia divaricata* (R.Br.) F. Muell.

Sclerolaena muricata (Moq.) Domin, *Biblioth. Bot.* 89: 624(1921). Basionym: *Anisacantha muricata* Moq., Chenopodearum Monogr. Enum. 84(1840). Synonym: *Bassia quinquecuspis* (F. Muell.) F. Muell. teste Scott, l.c. 113.

Sclerolaena muricata var. **villosa** (Benth.) Ulbrich, in Engler & Harms, *Natürl Pflanzenfam.*, ed. 2, 16c: 533(1934). Basionym: *Anisacantha muricata* var. *villosa* Benth., Fl. Austr. 5: 199(1870). Synonym: *Bassia quinquecuspis* var. *villosa* (Benth.) R. H. Anderson teste Scott, l.c. 113.

Sclerolaena obliquicuspis (R. H. Anderson) Ulbrich, in Engler & Harms, *Natürl. Pflanzenfam.*, ed. 2, 16c: 533(1934). Basionym: *Bassia obliquicuspis* R. H. Anderson teste Scott, l.c. 113.

Sclerolaena parviflora (R. H. Anderson) A. J. Scott, *Feddes Repert. Spec. Nov. Regni Veg.* 89: 114(1978). Basionym: *Bassia parviflora* R. H. Anderson.

Sclerolaena patenticuspis (R. H. Anderson) Ulbrich, in Engler & Harms, *Natürl. Pflanzenfam.*, ed. 2, 16c: 534(1934). Basionym: *Bassia patenticuspis* R. H. Anderson teste Scott, l.c. 114.

Sclerolaena ramsayae (J. H. Willis) A. J. Scott, *Feddes Repert. Spec. Nov. Regni Veg.* 89: 114(1978). Basionym: *Bassia ramsayae* J. H. Willis.

Sclerolaena tricuspis (F. Muell.) Ulbrich, in Engler & Harms, Natürl. Pflanzenfam., ed. 2, 16c: 534(1934). Synonym: *Bassia tricuspis* (F. Muell.) R. H.

Anderson teste Scott, l.c. 114.

Sclerolaena uniflora R.Br. Synonym: *Bassia uniflora* (R.Br.) F. Muell. teste Scott, l.c. 114.

Solanum brownii Dunal, Hist. Nat. Solanum 201(1813). Synonym: *S. violaceum* R.Br. (1810) non Ortega (1798) teste Hepper, *Bot. J. Linn. Soc.* 76: 291-292(1978).

Solanum hermannii Dunal, Hist. Nat. Solanum 212, t. 2 fig. B (1813). Synonym: *S. sodomeum* auctt. non L. teste Hepper, l.c. 292 and *Taxon* 27: 555(1978).

Solanum sodomeum auctt. non L. See *S. hermannii.*

Solanum violaceum R.Br. See *S. brownii.*

Solenogyne bellioides Cass. var. **gunnii** (Hook.f.) G. L. Davis. See *S. gunnii.*

Solenogyne gunnii (Hook.f.) Cabrera, *Blumea* 14: 307(1966). Synonym: *S. bellioides* Cass. var. *gunnii* (Hook.f.) G. L. Davis teste L. G. Adams, *Brunonia* 2: 55(1979).

Sonchus asper (L.) Hill. forma **hydrophilus** (Boulos) Koster, *Blumea* 23: 165(1976). Basionym: *S. hydrophilus* Boulos in Eichler, Suppl. Black's Fl. S. Aust. ed. 2: 331(1965).

Sonchus hydrophilus Boulos. See *S. asper* forma *hydrophilus.*

Spiranthes sinensis (Pers.) Ames. The taxon found in Australia is the ssp. *australis* (R.Br.) Kitamura, teste W. M. Curtis, Stud. Fl. Tas. 4A: 128(1980).

Stelligera endecaspinis A. J. Scott, *Feddes Repert. Spec. Nov. Regni Veg.* 89: 115(1978). Synonym: *Bassia stelligera* (F. Muell.) F. Muell.

Stipa compacta D. K. Hughes. See *S. flavescens.*

Stipa elatior (Benth.) D. K. Hughes. See *S. flavescens.*

Stipa falcata D. K. Hughes, *Kew Bull.* 1921: 14(1921). Teste Townrow, *Pap. & Proc. Roy. Soc. Tas.* 112: 267-270(1978) this species is distinct from *S. variabilis* D. K. Hughes.

Stipa flavescens Labill., Novae Holl. Pl. Specim. 1: 4(1804) includes both *S. elatior* (Benth.) D. K. Hughes and *S. compacta* D. K. Hughes teste Townrow, l.c. 237.

Stipa mollis R.Br., Prodr. 174(1810). Synonym: *S. semibarbata* R.Br. var. *mollis* (R.Br.) Benth. teste Townrow, l.c. 242.

Stipa pubescens auctt. Vict. non R.Br. See *S. pubinodis.*

Stipa pubinodis Trinius et Ruprecht, *Mém. Acad. Imp. Sci. St.-Petersbourg, Sér. 6, Sci. Math.* 5: 50(1843) preprinted as Species Graminum Stipaceorum, Petropol. (1842). Synonym: *S pubescens* auctt. Vict. non R.Br. teste Townrow, l.c. 251-255.

Stipa semibarbata R.Br. var. **mollis** (R.Br.) Benth. See *S. mollis.*

Thelymitra aristata sens. auct. Austr. non Lindl. See *T. megcalyptra.*

Thelymitra carnea R.Br. var. **rubra** (R. D. FitzG.) J. Z. Weber & R. Bates in J. M. Black. Fl. S. Aust., ed. 3, pt 1 (revised Jessop): 455 (1978). Synonym: *T. rubra* R. D. FitzG. See Bates in *Native Orchid Soc. S. Aust. J.* 3: 18(1979).

Thelymitra decora Cheeseman, Manual New Zealand Fl. 1151(1906). Synonym: *T. ixioides* Sw. var. *truncata* (R. S. Rogers) W. H. Nicholls and *T. truncata* R. S. Rogers. See Weber & Bates in J. M. Black, Fl. S. Aust. ed. 3, pt 1 (revised Jessop): 456(1978), and R. Bates in *Native Orchid Soc. S. Aust. J.* 3: 18(1979).

Thelymitra ixioides Sw. var. **truncata** (R. S. Rogers) W. H. Nicholls. There are differing opinions about the status of this taxon. See *T. decora* and *T. truncata.*

Thelymitra megcalyptra R. D. FitzG. Synonym: *T. aristata* Lindl. var. *megcalyptra* (R. D. FitzG.) W. H. Nicholls. The species previously known erroneously as *T. aristata* has recently been referred to as *T. megcalyptra.* The application of the name *T. aristata* is not clear. The complex which contains *T. aristata* sens. auct. Austr., as well as *T. pauciflora* R.Br., *T. nuda* R.Br. and *T. longifolia* J. R. & G. Forst., is in need of further study.

Thelymitra rubra R. D. FitzG. See *T. carnea* var. *rubra.*

Thelymitra truncata R. S. Rogers. Synonym: *T. ixioides* Sw. var. *truncata* (R. S. Rogers) W. H. Nicholls. See W. M. Curtis, Stud. Fl. Tas. 4A: 45(1980).

Trithuria—transferred to the new family Hydatellaceae by Hamaan, *New Zealand J. Bot.* 14: 193-196(1976).

Uncinia compacta R.Br., Prodr. 24 (1810). Synonym: *U. flaccida* S. T. Blake teste Nooteboom, *Blumea* 24: 516(1978).

Uncinia flaccida S. T. Blake. See *U. compacta.*

CORRECTIONS TO CONSPECTUS 1.

Erigeron conyzoides F. Muell. was given on p. 183 as an introduced species. It should have been included amongst the indigenous as Mueller described the species in 1855 from material collected "On the sources of the Murray and Snowy rivers at about 4,000-5,000 ft." (*Trans. Philos. Soc. Vict.* 1: 105(1855)).

Juncus kraussii Hochst. was given on p. 178 as an additional indigenous species. However, according to Dr. L. A. S. Johnson (pers. comm. 1980), the form of this species which is present in Australia has been known here previously as *J. maritimus* Lam. var. *australiensis* Buch. and is recorded under that name by Willis (1970). The new combination of the variety under *J. kraussii* has not yet been made.

Microtis holmesii W. H. Nicholls. See *M. parviflora.* (Insert on p. 194).

Microtis unifolia (Forst.f.) Reichenb.f., on p. 194. Alter the synonym *M. bilobata* to *M. biloba.*

Solanum gracilius Herter was listed on p. 181 as indigenous. It is, however, introduced, being native to South America.

ACKNOWLEDGEMENTS

Many people have assisted in making this compilation of information possible. Mr T. B. Muir has again undertaken full responsibility for the family Orchidaceae. Others who have helped include Miss H. I. Aston, Mr A. C. Beauglehole, Dr B. G. Briggs, Mr M. I. H. Brooker, Mr Barry Conn, Mrs M. G. Corrick, Miss Jean Galbraith, Dr P. Gullan, Mr L. Haegi, Dr Surrey Jacobs, Dr L. A. S. Johnson, Dr Andrew Kanis, Mr P. F. Lumley, Dr R. F. Parsons, Dr Jocelyn Powell, Mr H. K. Airy Shaw, Mr B. K. Simon, Mr R. V. Smith, Mr P. G. Wilson and those mentioned incidentally in the text, particularly those who collected new plants. The author wishes to express her thanks to all these people.

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Manuscript received 21 July 1980.

BOOK REVIEW

Acacias of South Australia. D. J. E. Whibley with assistance from N. N. Donner. Illustrated by L. Dutkiewicz. Handbooks to the Flora and Fauna of South Australia. Government Printer, South Australia. 29 February 1980. 240 pp.; 40 col. & 60 b. & w. photographs; 104 b. & w. figures. Price $7.90 plus postage.

The genus *Acacia* is one of the most widespread and important in Australia and its species form such a conspicuous feature of much of the vegetation that there is a demand for information about them. *Acacias of South Australia* with its informative text, illustrations and photographs certainly satisfies this demand for the 97 species of *Acacia* recognized as occurring in South Australia at the time the book was published.

The taxonomic complexity of the Australian *Acacia* species present formidable problems in classification and identification. Mindful of these difficulties, the author has provided an excellent illustrated key in addition to the more conventional descriptive key. The illustrated key is designed to enable the identifier to first compare the specimen with the illustrations in Figure 1 in which the species are divided into seven groups. After assigning a specimen to one of these groups, the identifier turns to the relevant Figure in which all of the species within that group are illustrated. Although more laborious, the descriptive key nevertheless offers a generally more reliable way of identifying a specimen.

Each species is illustrated by excellent black and white line drawings and a habit photograph (many in colour), and a map showing the distribution within South Australia is provided. It would have been useful to cite in the captions the herbarium specimens from which the illustrations were drawn. Where available, common names are given along with the derivation of the specific epithet and relevant synonymy. Species descriptions are concise and notes on flowering times, habitat, cultivation, uses and related species are provided. The book also contains a useful glossary and a distribution chart recording the presence or absence of each species within the 13 phytogeographic regions into which South Australia is divided by the State Herbarium.

The Egyptian thorn is referred to on p. 34 as *A. arabica.* However, the correct name for this plant is *A. nilotica* (L.) Willd. ex Del.: *A. arabica* is a synonym. *A. nilotica* is a very widely distributed and polymorphic species within which nine subspecies are currently recognized. The taxon referred to in the note at the foot of p. 218 under *A. nilotica* is either subsp. *tomentosa* (Benth.) Brenan or subsp. *indica* (Benth.) Brenan, the two subspecies being distinguished primarily on the nature of the pubescence on the young branchlets (not mentioned in the description provided). The two specimens referred to under *A. arabica* are likewise referable to a subspecies of *A. nilotica.*

It is disappointing to find no reference to the existence of a new species in the north-western region of South Australia described as *A. symonii* Whibley, in *J. Adelaide Bot. Gard.* 2(2): 167-169 (13 May 1980), less than three months after the publication of the book. For the sake of completeness, it would have been appropriate to mention this species in the book, even as *Acacia* sp. nov. However, taxonomic botany is an unending synthesis and it is, of course, impossible to achieve finality, especially in a genus as large and complex as *Acacia.* Presumably *A. symonii* will be incorporated into the second edition of this very useful book along with other additions and alterations.

The book was written for the professional botanist, amateur enthusiast and layman and the contents satisfy the requirements of all parties. It is well produced, inexpensive, and a convenient size (21 × 15 cm) suitable for use in the field. *Acacias of South Australia* is bound to stimulate further interest in this fascinating genus and the author and his colleagues are to be warmly congratulated on a fine piece of work.

J. H. Ross

BOOK REVIEW

Flora of New Zealand. Volume 3, Adventive cyperaceous, petalous and spathaceous monocotyledons. A. J. Healy and E. Edgar. Published by the Government Printer, Wellington, New Zealand, 1980. xlii. 220 pp., 3 figures including 4 coloured. Price $NZ18.50.

This volume of the new 'Flora of New Zealand' is not the awaited treatment of the Gramineae but covers, instead, adventive monocotyledons from the families whose indigenous representatives comprised volume 2.

Adventive species include those which have been introduced accidentally and grow spontaneously in New Zealand such as *Juncus bufonius* and also those that have escaped from cultivation and have persisted in the wild, such as *Trachycarpus fortunei.* Both categories contain aggressive weedy species.

In their introduction, the authors discuss the treatment of adventive species in previous floras of New Zealand. They point out that these species have traditionally been omitted from accounts of the native flora, a situation they regard as unsatisfactory: "Ultimately a Flora of New Zealand must encompass both native and adventive species in the one treatment".

The present volume of 220 pages is relatively long for its intended treatment of only 168 adventives because the authors have devoted much space to ensuring that it can be used effectively as an identification manual. To this end, the general keys at the front of the volume and the family keys to genera all include both native and adventive taxa. In the eight genera which contain both native and adventive species, *Potomogeton, Cordyline, Juncus, Luzula, Centrolepis, Carex, Cyperus* and *Scirpus,* the keys feature all species and descriptions are given of each. This makes the volume particularly useful for large difficult genera like *Carex* (22 adventive, 73 native species) and *Juncus* (31 adventive, 16 native species). In all, descriptions of 134 natives have been included.

The format of the (species) descriptions is the same as in earlier volumes but descriptions of indigenous species are shortened. The first record and first collection are given for adventive species and in the case of serious weeds information about dispersal is included. Problems of nomenclature, diagnosis and variation are dealt with where appropriate.

Notes are also given on species recorded as garden escapes, but not regarded as sufficiently well-established to merit full treatment.

A number of useful black and white figures illustrate many confusing features such as habit and inflorescence form in *Juncus.* However more figures of *Carex* species would have been welcome. The coloured illustrations of flowers of various petalous monocotyledons are of inferior quality and might well have been omitted.

The annals of taxonomic research on New Zealand Tracheophyta are continued from Volume 2 and cover the years 1969-1976; there is also a family index to the annals.

The layout of the book is excellent, the nomenclature up-to-date and the lack of typographical errors impressive. The volume strikes a sound balance between the need for a field manual for identification and a reference work of use to taxonomists. I look forward to a volume on Gramineae which includes both native and introduced species.

PETER LUMLEY

CONTENTS

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